PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

VOL. IV. 1858–59. No. 49.

SEVENTY-SIXTH SESSION.

Monday, 22d November 1858.

DR ALISON, Vice-President, in the Chair.

The following Council were elected :—

President.

SIR T. MAKDOUGALL BRISBANE, BART., G.C.B.

Vice-Presidents.

Sir DAVID BREWSTER, K.H.
The Very Rev. Principal LEE.
The Right Rev. Bishop TERROT.
Dr CHRISTISON.
Dr ALISON.
Professor KELLAND.

General Secretary,—Professor FORBES.

Secretaries to the Ordinary Meetings,—Dr BALFOUR, W. SWAN, Esq.

Treasurer,—J. T. GIBSON-CRAIG, Esq.

Curator of Library and Museum,—Dr DOUGLAS MACLAGAN.

Councillors.

Dr THOMAS ANDERSON.
Rev. Dr HODSON.
ROBERT CHAMBERS, Esq.
JOHN RUSSELL, Esq.
JOHN HILL BURTON, Esq.
DAVID STEVENSON, Esq.
WM. THOS. THOMSON, Esq.
Dr ALLMAN.
The DUKE of ARGYLL.
ANDREW MURRAY, Esq.
Dean RAMSAY.
Dr GEO. WILSON.

Monday, 6th December 1858.

PROFESSOR KELLAND, Vice-President, in the Chair.

1. Opening Address. By Professor Kelland.

During the vacation, I had looked forward with confidence to the pleasure of listening to-night to an address from one of the ablest experimenters and most vigorous writers that this Society has ever numbered amongst its members,—Sir David Brewster. And when, a short time since, I learnt that I had been indulging an ill-founded expectation, and that the duty of opening the session was to fall to my own lot, I experienced something more than disappointment. For, in addition to my imperfect knowledge of the past history and present position of the Society, is the fact that I had made no preparation, either in the way of collecting materials, or of providing a reserve of time, for drawing up an address. I must therefore come before you with an apology. I must crave your forbearance should some of the remarks which I make appear trite and unworthy of the occasion,—should others be traceable to what I have said elsewhere,—should all be found crude and lower in tone than beseems the position in which your kindness places me.

The primary topic in such an address must be one suggested by the first glance which the eye takes around the room on every opening session—the record of the changes which death has effected in our body. The list of members deceased within the year is, I regret to say, unusually large, comprising no fewer than two honorary, and fifteen ordinary Fellows. Amongst these are names of note, —such as those of Lord Dunfermline, the Lord Justice-Clerk Hope, and Lord Handyside,—men whose distinguished professional career has brought them prominently before the public, and the tribute to whose memory is recorded on broader pages than issue from this place. There are others, whose walks in life, and scientific pursuits in particular, brought their doings more directly under our notice, —such as Dr Fleming, Professor Gregory, Mr Jamieson Torrie, Mr Tod, Mr Jardine, and Mr Morries Stirling.

In selecting some of these for a few brief remarks, I trust it may not be inferred that I deem the others little worthy of notice. A sketch of the labours of Dr Fleming has already been laid before the Society. A brief notice of Professor Gregory has been drawn up by Dr Alison, and he has come here to-night to present it to the Society in person. Time and opportunity have been wanting to me to collect extensive information respecting Mr Tod and Mr Jardine; whilst in the cases of Mr Jamieson Torrie and Mr Morries Stirling, I have had the advantage of the kind assistance of Dr Balfour, Dr Christison, and Mr Andrew Coventry.

Suffice it to say, that Mr Tod was for no less than twenty-nine years Secretary to the Royal Scottish Society of Arts, the duties of which office he discharged with such efficient and ready zeal as to have rendered himself ultimately the centre and moving power of that Society, by every member of which he was highly and deservedly esteemed. On our own meetings he was a regular attendant; but he reserved his active energies for the Society to which his tastes and his official position more directly attached him. As a disinterested patron of youthful inventors, as a friend to every unfriended projector, his loss will be severely felt.

Of Mr Jardine all I can collect is, that he possessed keen intelligence and great mathematical powers. In his early career he is said to have given promise of the highest eminence, attracting the attention of Professor Playfair, to whom he was under deep obligations. I possess a copy of a book presented to him by the author—the Supplement to Legendre's "*Théorie des Nombres.*" The testimony, even to this extent, of so distinguished a man as Legendre, is no small matter. Mr Jardine appears to have been too easily satisfied with the position which his professional skill as a civil engineer secured him, to admit of his using the exertion requisite for figuring in a broader sphere. His attainments, however, were by no means limited to a knowledge of his profession.

Fifty years ago, when geology was not a common study, Mr Jardine laboured in that field; but the fruits of his labours were, so far as I know, communicated only to his friends. It was a merit even to study amongst the rocks in those days; when the country-people were not accustomed, as they are now, to meet with gentlemen converted for the time into stonebreakers. Professor Sedgwick tells a story of his arriving late, hammer in hand, and groaning under a load of specimens, at a little inn in some remote district, and of the worthy Boniface bringing out in turn each of his children from its bed to have a look at the "daft" man. I am reminded of this story by what I have been told of Mr Jardine. When Professor Jameson was on his first visit to Arran, collecting materials for the mineralogy of the island, he on one occasion arrived, after nightfall, at a public-house near Loch Ranza, and asked if he could obtain some refreshment and a bed. The reply was, "Aye, aye, ye may hae some refreshment, but for a bed ye maun e'en lie down beside that man on the table." To Jamieson's no small delight and astonishment, "that man" was his friend Jardine, sound asleep, after a hard day's geologizing amongst the hills.

Thomas Jameson Torrie, Esq., Advocate, evinced in early life a fondness for natural science, which, under the able tuition of his uncle, Professor Jameson, resulted in his becoming an excellent mineralogist and geologist. He was also distinguished in Botany. He became a member of the Plinian Society in 1824, and was elected President of that Society in 1827. He contributed papers to the Society, and proved himself a zealous student of natural science. In 1828 he joined the Wernerian Society, and became ultimately associated with Dr Neill in the secretaryship. Owing to his retiring habits, Mr Torrie did not appear much in public, either as a speaker or as a writer. He did much, however, to encourage science, by the ample collections which his independent fortune enabled him to accumulate. He had travelled extensively, and was well acquainted with the geology of Europe. To the loss of science, he was attacked, whilst in the vigour of life, by rheumatism, brought on by exposure. The attack was succeeded by partial paralysis, which affected both his powers of memory and his speech. Hence it happened that for many years, whilst warmly interesting himself in all that was doing in natural history, his own participation in the labours of scientific progress was effectually stopped. He was much beloved by an extensive circle of friends.

Mr John Davy Morries Stirling, was son of Captain Morries, of the Royal Navy, and nephew of Major Davy, a distinguished officer, who perished in captivity in Candy in Ceylon, after the well-known fatal expedition against that capital early in the present century. Mr Morries was educated in Edinburgh for the medical profession, and graduated in 1831, after having given great promise as a student. Both before and after graduation he showed a preference for chemical inquiry, and manifested an aptitude for original research. To him is due the discovery of one of the neutral crystalline proximate principles of the vegetable world, *elaterine*, the active ingredient of *elaterium*, which was also made known by the late Mr Hennell of London about the same time. Subsequently, the first appearance of the malignant cholera, in 1832, attracted his ardent mind,—at the time a subject of universal and intense interest,—and thus, for a period, the practice of his profession became the object of Dr Morries' life; and he settled in London as a physician. Circumstances soon led him, however, to give up that pursuit; and marriage with a lady of property, sister of the present Mr Stirling of Kippendavie, occasioned a change of name, and the abandonment of all professional objects. Not long after his marriage Mr Morries Stirling took up his residence in Norway, where he remained several years. The account of the discovery of the admixture of metals, on which was founded his patent iron, and several other patents, which have been successfully worked, I owe to the kindness of Mr Andrew Coventry. When residing in Norway, Mr Stirling devoted his time to field-sports, in which he engaged with great enthusiasm. Hunting, shooting, and fishing occupied his days whenever it was possible to get abroad. But, as the weather was not always propitious, he was sometimes kept within doors. On these occasions, he tried his hand at the construction of the implements used in the field. On one occasion, he was astonished to find the fish-hooks, which his experiments had produced, to possess wonderful toughness, quite different from anything he had previously turned out. With a true philosophic spirit, he set about diligently to search out the cause. Had he done anything unusual? Was there any element, either of matter or of manner, to which he might attribute his success? He could discover none. But his man, on being questioned, remembered that they had stirred the molten metal with a tin spoon. On this hint, he repeated the experiment, and the result was the patent iron, which consists of a mixture of iron with tin or some other metal. To this he has added other patents of great value. And here permit me to offer a word of caution to our younger Fellows. The principle of division of labour seems almost to be a law of nature—it is certainly a law of society. The genius which evolves a scientific invention is rarely, very rarely indeed, combined with that genius which can turn it to profitable account. A tightly-strung mind, capable of working out scientific truths, is hardly able to sustain the rough shocks which it meets with in the commercial world. Mr Stirling found his patents, successful as they were in some respects, a constant source of annoyance, under which his sensitive frame gave way. Others profited: he suffered. *Sic vos non vobis.*

The names o the other ordinary members deceased are,—Sir David Hunter Blair, Bart.; James M. Hog, Esq. of Newliston; William Murray, Esq. of Monkland; John Sligo, Esq. of Carmyle; Dr John W. Watson; and William Wood, Esq.*

Of foreign members, we have lost M. Von Hammer the Orientalist, and Müller the Physiologist.

Little remains to be added to complete the past year's history of the Society. The papers read at our ordinary meetings have presented the usual diversity of subject; embracing Mathematics, Physics, Chemistry, Natural History, and Archæology. Nor am I aware that their value has been below the average; but, from the circumstance that several of the most important papers were incomplete, combined with the fact that shorter papers are now more generally condensed into our Proceedings than was the case formerly, the annual addition to our Transactions this year contains but one paper. That paper is by Mr Stewart, and is of unquestionable merit. I have great pleasure in learning that Mr Stewart is continuing his researches on radiant heat,—a branch of experimental science which owes so much to members of this Society, and the papers on which alone suffice to stamp our Transactions with lasting value. I ought to add, that Mr Stewart has been selected by the Council to take charge of the reduction and printing of the "Makerstoun Magnetical and Meteorological Observations," at the joint expense of Sir Thomas Brisbane our President, and of the Society, with which work he is progressing rapidly and satisfactorily. Having thus briefly touched on the occurrences which make up the history of the Society during the past year, I will venture on a few general remarks.

I have no fear that the principles which should regulate such associations as this are likely to be much misunderstood or widely departed from. Still, a few words on the subject may not be inappropriate to the occasion. There are two errors which we must carefully guard against in our practice:—the one, that of imagining this room to be a place proper for the exposition of old truths,—in other words, as in any sense a lecture-room; the other, that of regarding our Society as, to any large extent, a combination of force, a union of physical and pecuniary appliances wherewith to attack problems and institute experimental researches which could not readily be dealt with by individuals. It is quite true that most of the old learned societies were established with a view to one or the other of these objects. The Academia del Cimento, for instance, was founded for the purpose of instituting experiments on a scale which no individual philosopher of that age durst have ventured on single-handed. So, too, of the Royal Society of London. The writings of Bacon had just opened a wide vista to the eye of the investigator of nature, and from this cause, amongst others, men's minds were beginning to entertain hankerings after new forms of truth. To the eye of the philosopher, who sees in the retardation and gradual dispensation of knowledge the hand which retains the shower until the seed has lain its full time in the earth, the phenomenon is neither startling nor inexplicable, of men hurrying to and fro under the influence of some excitement, whose determining period is in the future. The old Royal Society was assuredly composed of men drawn together by strange unearthly longings, the interpretation of which must be sought for in the subsequent quarter of the century, when the "Principia" and strict experimental philosophy had come in. The pages of Birch indicate plainly enough what was the object of that Society at its first formation. They reveal to us the fact, that the streams of truth had stagnated so long amongst the marshes of the Middle Ages as to have become altogether polluted, so that an individual thirsting for its waters found himself utterly suffocated, utterly helpless, in attempting to search out the pure descending rill. Impelled by this feeling of inability, men clung to each other, held firmly hand to hand, and thus united marched on. We may smile at the apparent frivolity of many of their earlier papers, but they convey their lesson notwithstanding. Their first President, Sir Robert Moray, on the day of his first election, 6th March 1661, gives in a marvellous paper, in which he tells his hearers, that the drift-wood cast ashore on the Western Isles of Scotland is incrusted with multitudes of little shells, having within them little birds perfectly shaped, supposed to be barnacles. " The bird in every shell that I opened," he says, " as well the least as the biggest, I found so curiously and completely formed, that there appeared nothing wanting as to the external parts for making up a perfect sea-fowl; every little part appearing so distinctly, that the whole looked like a large bird seen through a concave or diminishing-glass, colour and feature being everywhere so clear and neat. The little bill like that of a goose, the eyes marked, the head, breast, neck, wings, tail, and feet formed ; the feathers everywhere perfectly shaped," and so on.

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* Whilst I write, there reaches me intelligence of the death of two other ordinary members—Lord Haddington and Mr Alexander Adie, both at an advanced age.

We may smile, I say, at this tendency to interpret natural phenomena by the aid of a vigorous imagination, but we must admit that it was better than that stolid uninterpretativeness which preceded it; and, at any rate, it ended in the clear day of truth which the next generation saw in full blaze. The object of an association at such a period was, from the nature of the case, union of minds and hands in questioning nature. What could one man hope to do by his own intellect, by his own resources? Accordingly, we are not astonished to find that the primary objects which men proposed to attain by union in those days were natural instruction, and assistance in common inquiry. The Society's minutes of the period abound in the language of entreaty. Every man who had a chance of getting at information was earnestly called upon to avail himself of it. And we are not to condemn men, through the application of our superior enlightenment, because, like the Florentine academicians, they made it a rule to believe everything possible until the contrary could be proved. They were justified, I think, in ordering fresh hazel rods to be produced, " wherewith the divining experiment was tried and found faulty." And we cannot blame them because, when the Duke of Buckingham had presented the Society with a piece of a unicorn's horn, they proceeded to try its virtues in retaining within a charmed circle a poor spider, which, however, contrived to run away spite of their repeated efforts.

Now, our circumstances are very different from theirs. Physical science is not, as it was then, a dreamy mystery, struggling for life in the breasts of a few speculative philosophers. It has made itself eyes in the telescope, arms in the steam-engine, wings in electricity. It is a living thing. Men may now rest on science itself for support, and not on each other. It is only extreme cases of views pushed beyond the ideas of the age,—of views anticipatory of the future of science,—that seem to demand the support of societies. We may admit respecting some of the generalizations of Faraday and Owen, for example, that had they emanated from some remote, unheard of country-side, they would have made no immediate impression, and would have fairly seen the day only in the next generation as singular foreshadowings of doctrines then familiar. But these are exceptions, not the rule.

Neither is combination now, as of old, essential to the prosecution of experimental research. Societies, in their corporate capacities, are no longer searchers after truths. They leave that work to individuals. Not only are we not called on to unite in the prosecution of experiments, but it rarely even happens that we are called on to lend pecuniary aid to such objects. It is possible that this Society may have been too restrictive in its grants for the prosecution of experiments; but assuredly this is an error in the right direction. A Society like this should never, as it appears to me (but I, of course, give my individual opinion only), by its funds undertake researches which may either prove of doubtful value on the one hand, or form an honourable incentive to individual energy on the other. The only reasonable grounds on which I can imagine grants of this kind may be legitimately founded, are these three:—The reduction of experiments already made; the repetition or examination of old experiments; and the continuation of researches which have been presented to the Society and approved by them. And that the Society, through their Council, have practically recognised these principles will appear, when I mention that the grants which have been made during the last twenty-five years have been limited almost exclusively to the purchase of magnetical and meteorological apparatus, and to the reduction of the observations made at the Makerstoun Observatory, at the Calton Hill, and at Mr Adie's residence.

Having now pointed out what are not the objects of such a Society as this, I may be fairly expected to state what I consider those objects to be. They appear to me to consist mainly of these two,—mutual influence and publication.

The end of our intercourse is encouragement and guidance, often even restraint. The history of the world tells many a sad tale of the waste of solitary strength. Some of the most illustrious names even have suffered from the want of cotemporary corresponding genius. Witness Roger Bacon, Tycho Brahe, Landen. But this is not all. The injury which great men sustain from want of collision is not half so blighting as that which they occasionally communicate. It is the prerogative of a commanding intellect to create for itself a sort of worship, and this worship is the certain cause of the retardation of that branch of knowledge on which it has erected itself. Take Newton. When his philosophy was once mastered by his countrymen, they felt themselves elevated with him to the highest pinnacle of excellence. Here was a system of reasoning which opened all the avenues of human knowledge. They naturally considered that, in order to advance, they had only to pursue the track which he had beaten down. Progress was in their eyes simply extension of what Newton had done, and *as* he had done it. On the Continent there was no such reverence for Newton's name. Of his labours, it is true, men gladly availed themselves; but whilst bowing to his conclusions, they yielded no obedience to his methods. In respect to the Differential Calculus, Leibnitz and his followers had adopted, from the first, an alphabetical notation capable of combining with the other characters which enter into analytical reasoning,—a mode of representation as superior to that of Newton as the plain English of my pen is to the Egyptian hieroglyphics. And what followed? Whilst the continental mathematicians pushed triumphantly through the thickets of science, opening up everywhere districts rich in fertility, the English timidly followed them at a vast distance, contented now to clear away a stump, now to explore a secluded nook which the continental mathematicians in their hasty sweep over the country had passed by unnoticed. Is this to be accounted for by a difference in the genius of the people? I think not. For, since the abandonment of their old methods, since the introduction of improved processes by Peacock, Herschel, and Babbage, our island has produced mathematicians of the very highest stamp, inferior to none of their generation. The simple explanation seems to be, that our countrymen were bound hand and foot in the chains of the beautiful but inexpansible systems of Newton, and rapid progress was to them an impossibility. Nor is Newton the only great man whose influence has been excessive, and to that extent injurious. The very same thing had occurred in France in the preceding generation; and Newton and the "Principia," actually broke down the evil influence in France which they contributed to erect in England. The seventy years which lie half in the seventeenth, and half in the eighteenth century, constitute the most barren period of French science. A brilliant constellation,—Pascal, Fermat, Mersenne, with Descartes at their head,—had just set, and thick and long-continued darkness followed. The brightness of Descartes had blinded the eyes of science. Need I refer to an earlier period, when a similar influence effectually checked all progress, until Galileo broke the chain which had held the civilized world in bondage for centuries,—a chain which Aristotle, a mighty genius like Newton and Descartes, had bound about his followers. In a minor degree, the same influence has been exerted by Bacon, by Locke, and by others. Now, surely it may be expected that a Society like this, not restricted to men of one science, nor even to men of science at all, but embracing every department of human knowledge, should operate powerfully as a preventive to the recurrence of such evils. The influence of great men is rarely injurious, except at a distance, or after their personal influence has disappeared. It was so in the case of Newton. Contact destroys erroneous impressions,—changes evil into good. Correspondence and cotemporary publication produce much of the same effects. Hence great names always appear in clusters. Hooke and Huyghens, and Leibnitz and the Bernoullis, lived around Newton. It was after his death that his countrymen placed him on a solitary pedestal. Minds, like trees, spring upwards from their mutual shelter. The poet's "lodge in some vast wilderness;" the dreamland of literary leisure is not the soil in which great thoughts thrive. Real science, real philosophy, I had almost said real poetry, comes from the dwellers among their fellow-men,—comes from the smoke of great cities. The heart of man drinks in inspiration from the thoughts which are floating about it. Thus, for example, in the science of optics,—a science which seemed to be exhausted,—Malus and Biot, and Young and Brewster, and Fresnel and Arago, mutually influenced each other, and their influence extended to Fraunhofer and Cauchy, and Wollaston and Seebeck, and Airy and Herschel and Plateau, and Wheatstone and Purkinje, and Hamilton and M'Cullagh, and Lloyd and Stokes; until the list of men raised to enduring fame by a single worn-out science is too long for enumeration.

Unquestionably a large amount of the influence which is here traceable is due to publication rather than to personal contact. And this fact brings before us one of the most valuable elements of our union. The writings of deep and original thinkers in any science are not likely to be self-supporting. If successful, their success must be slow. It is only a reputation of the highest order that can ensure the sale of heavy thought. Youthful discoverers have no chance of success. In some departments of knowledge, so crushing is this expense of publication, as even to destroy societies. The Memoirs of the Analytical Society, containing papers by the greatest mathematicians of Britain, reached but one volume, of which, probably, not half a dozen copies were ever sold. "The Mathematician," and the "Cambridge and Dublin Journal," have ceased to exist. The advantage of a large society like this is, that it constitutes both the publisher and the public. Thus papers uninteresting to the mass, perhaps even uninteresting to all at the time of their publication, are handed down to future thinkers, where, in a newly turned up soil, they may grow and produce rich fruit. The work of publication is perhaps our greatest work,—perhaps our properest work. The torch of truth is hereby trimmed and passed on from age to age. The great English philosopher describes man as the interpreter of nature. But this is not his characteristic designation ; for are not the beasts, are not the birds, are not the very insects, interpreters of nature ? It is as the interpreter of man—the interpreter of man's records—that man stands distinguished. Thus reason transcends instinct that its gifts are transmissive and cumulative. Mind does not stand supported by the mind which exists around it,—not simply, not mainly,—there is a higher and a broader support. The minds of the great of by-gone ages live and work in the breasts of their successors. The old Greeks, I suppose, knew this, and embodied it in the fable of Athene, the goddess of knowledge, who sprang into existence, not as a naked, helpless child, but as a grown-up being, clad in complete armour, from the head of Zeus.

Hence the importance of publication. It is at once the food of existing thought and the seed of future knowledge. A society such as ours has some little difficulty, it may be, in rendering its two functions of personal influence and of publication harmonious. Personal intercourse may operate injuriously on publication. It may reasonably be expected to swell our Transactions with unimportant papers, the contributions of members whose merits are viewed by too friendly an eye. On the other hand, publication may tend to sour personal intercourse. If such papers only are selected as are likely to prove valuable to cotemporary and future thinkers, there is a possibility that disappointment may ensue, and with it ill fellowship. The Council have a difficult duty in this respect, and they act wisely in referring the papers presented to them, in every case where there is the slightest doubt, to parties at a distance, out of the sphere of local influence. The estimation in which our Transactions are held is an evidence at once of the care which is bestowed in the selection of papers, and of the high scientific position of the Society. To you, the existing members, is confided the duty of maintaining that position, and of upholding the character of our Transactions before the world.

2. Account of the Life and Labours of Dr William Gregory. By Dr Alison.

Dr Gregory, at the time of his death, which took place on the 24th of April last, was Professor of Chemistry in the University of Edinburgh, and one of the Secretaries of this Society. He was born on the 25th of December 1803. His father was the late Dr Gregory; for a long time professor of the practice of medicine in the University of Edinburgh. His brothers, James Crawford, who took the degree of medicine in 1824, and died in 1832, and Duncan, who, when he died, was a Fellow of Trinity College, Cambridge, were both so highly distinguished for their talents and acquirements as to be worthy representatives of a family of no small distinction in the science and literature of the country; but, in Dr Alison's opinion, Dr William Gregory was the member of the family who, in our day, had shown the greatest original talent and devotion to science for its own sake. His love of science manifested itself at an early period. He had been present at an introductory lecture by Dr Hope, which was illustrated by striking experiments. Several of these experiments he contrived to repeat by means of a rude apparatus which he constructed for the purpose. From that time he had always before him the object of ambition which he ultimately attained. It was not, however, until he had made his name known throughout Europe as a chemist, as a favourite pupil and friend of Baron Liebig, and the approved translator of several of his works, and had established his reputation as a teacher of his favourite science in Edinburgh, Glasgow, Dublin, and King's College, Aberdeen, where he was appointed Professor of Chemistry in 1839, that he at length, in 1844, obtained the Chair of Chemistry in the University of Edinburgh.

Dr Alison next referred to Dr Gregory's published writings and scientific papers in proof of his command of practical chemistry, of his remarkable power of condensation and clear exposition of chemical principles, and of his just perception of the many important discoveries by which the science of chemistry was advanced during his lifetime. He had formed plans which, had his health permitted, would have resulted in a course of chemical instruction not surpassed in extent and importance in any single school in Europe.

It was, however, unfortunate for Dr Gregory, that though a man of large make, and capable during youth of much exertion both bodily and mental, he had neither opportunity nor disposition to take so much muscular exercise as would probably have suited his physical constitution. In consequence, also, of an attack of fever in 1826, he became liable, during the remainder of his life, to severe pain and swelling in one of his legs on any unusual exertion. It is, besides, worth notice, that he had repeatedly decided febrile attacks, which were distinctly traceable to the inhalation of sulphuretted hydrogen, and other gases, in his laboratory.

He was thus latterly compelled to restrict himself almost exclusively to occupations of a completely sedentary character, such as the acquisition of languages, for which his remarkably tenacious memory will fitted him, and the practice of music, in which he possessed a refined taste. Of late years his favourite employment was the use of the microscope: but this was not a mere amusement; for his systematic and laborious investigations resulted in various memoirs on the "Diatomaceæ," which he contributed to the "Transactions of the Royal Society of Edinburgh," and the "Microscopical Society of London."

The zeal which Dr Gregory displayed in the progress of his favourite science, chemistry, was never shown in a more interesting manner than in the composition of the "Notes on the Action of the Soil in Vegetation," which he drew up only a few days before his death, when he was with difficulty supported in bed, so as to enable him to write.

1. On the peculiar Appendage of Appendicularia, named "Haus" by Mertens. By Professor Allman.

In this communication the author called attention to the fact of his having discovered, in April last, in the Clyde, near Rothesay, numerous specimens of an Appendicularia, invested with the remarkable appendage, named "Haus" by Mertens, who originally described it in specimens captured in the North Pacific, near Behring's Straits, but which no one since his time had seen, though Appendicularia had become a subject of careful and elaborate investigation in the hands of several of the leading zoologists of the present day.*

The appendage under consideration agreed in its more essential details with that originally described by Mertens, except that no trace could be detected of the remarkable vascular network which Mertens describes as constituting so striking a feature in the specimens examined by him. There were also some differences in details of less importance,—such as in the size of the "Haus," which was here much smaller than in the Behring's Straits specimens, and in the number and shape of the bodies named "horns" by Mertens,—differences, however, which Professor Allman thinks may be referred to a difference of species in the specimens. The author also stated, that he had never witnessed the rapid renewal of the "Haus" after complete destruction, a phenomenon described by Mertens as constant.

Notwithstanding, however, these differences, Professor Allman had not the least doubt that the structure now described is the same, except specifically, with that originally described by Mertens.

2. Additional Observations on the Morphology of the Reproductive Organs in the Hydroid Polypes. By Professor Allman.

This communication was intended by the author to be in continuation of a former paper on the same subject, read before the

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* Dr S. Wright has since informed the author, that during the past autumn he observed Appendicularia in the Firth of Forth, invested with its "Haus."

Society during the previous session, and contained the following additional notices :—

Sertularia polyzonias, Linn.

The gonophore of *Sertularia polyzonias* consists of an oval capsule slightly corrugated transversely, with a short tubular, obscurely 4-toothed aperture, and having its axis occupied by a blastostyle, bearing in all the specimens examined a single sporosac.

The sporosac is produced at first as a lateral bud from the blastostyle, but soon acquires an apparently terminal position, being borne on the summit of an axile peduncle formed by the portion of the blastostyle which intervenes between it and the base of the gonophore, while the distal portion of the blastostyle seems to become more or less atrophied. The sporosac is furnished with a large simple manubrium, between whose ectoderm and endoderm the ova or spermatozoa are developed, the ectoderm retreating from the endoderm more and more as the intervening generative elements increase in volume, while the endodermal portion of the manubrium, with its cavity, continues to occupy the axis of the sporosac, extending into the middle of the mass of ova or spermatozoa. For this endodermal portion of the manubrium, round which the generative elements are developed in the sporosacs of the hydroid polypes, I have already proposed the term *spadix* ;* while to the ectodermal layer, which now constitutes a sac immediately confining these elements, we may give the term *endotheque*, as distinguishing it from the ectotheque, or external investment of the sporosac.

The ova and spermatozoa are of the usual form, and in the male sporosac the spermatogenous tissue may be observed in various stages of development. Towards the centre of the sporosac, where this tissue immediately surrounds the spadix, we find it in the condition of a thick mass of mother-cells filled with " vesicles of evolution ;" but as we recede from the centre towards the walls of the sporosac, the spermatogenous tissue may be seen to have advanced in maturity, the mother-cells having burst and liberated their contents, while in immediate contact with the endotheque is a zone of active spermatozoa, which, when liberated, are seen to be of the usual form of minute caudate corpuscles.

The generative elements are not absolutely confined to the sporosacs; they also exist between the ectoderm and endoderm of a slightly dilated portion of the peduncular blastostyle, immediately below the sporosac. I have, however, never seen them here, except in a very immature condition; and it is probable that from this situation they subsequently pass into the cavity of the sporosac.

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* British Association Reports for 1858.

As the gonophore advances towards maturity, the sporosac is elevated towards the summit of the capsule, both by its own increase of size and by the elongation of its peduncle; and we now find in the female gonophores that the contents of the sporosac become discharged through the aperture of the gonophore into an external oval sac, which at the same time makes its appearance on the summit of the capsule; the now empty and contracted sporosac, with its spadix, remaining behind in the interior of the capsule, on the extremity of its elongated peduncle.

This extra-capsular sac communicates through the aperture of the gonophore, by means of a short tubular neck, with the cavity of the sporosac. Its walls are composed of two layers; the external one shows no trace of structure, and looks like a gelatinous investment of the sac, but it is probably a delicate membrane, separated from the internal by a rather wide interval, which is filled with a liquid; while the internal one, or that which immediately surrounds the mass of ova, may be plainly seen to be composed of nucleated cells connected with one another by a structureless intercellular substance. The internal layer would seem to be a simple extension of the endotheque of the sporosac, which now becomes protruded, in the form of a hernia, through the aperture of the gonophore. The connections of the external layer are more obscure; but it will probably be found that this membrane is an extension of the endotheque of the sporosac.

The ova which now occupy the cavity of the extra-capsular sac are each found to be enveloped in a special sac, consisting of a very delicate structureless membrane, which closely embraces the ovum, and is then continued by a narrow elongated neck towards the aperture of the gonophore, through which it is probably further continued into the sporosac, but I was unable to trace it beyond this point.

The ova in the extra-capsular sac are in a more advanced stage of development than in the sporosac; segmentation has begun, and all traces of germinal vesicle and spot have disappeared. After segmentation has been established, the ovum may be easily broken down into distinct cells, with granular contents, but with no evident nucleus. It soon acquires a more elongated form, exhibits a manifest contractility of its walls, becomes clothed with vibratile cilia, and, finally, by the rupture of the confining structures, escapes as a free locomotive embryo into the surrounding water.

I have not as yet met with any instance of the occurrence of the extra-capsular sac in a male gonophore; and it would thus seem to constitute a kind of marsupial appendage, into which the ova are introduced from the interior of the gonophore, in order to undergo a further development previously to their final liberation as free larvæ. It occurs, with slight modifications, in several other species, and ought to have a place in the descriptive terminology of the group. I therefore, in allusion to its position on the summit of the gonophore, propose for it the name of *Acrocyst.*

We must be careful not to confound the acrocyst with an extra-capsular, medusa-like sporosac, which in certain species shows itself in a similar situation, but with which it is in no respect homologous,—the acrocyst being in an entirely different morphological category from that of the sporosacs.

Sertularia pumila, Linn.

The gonophores in this species are compressed, urn-shaped bodies, generally containing a single sporosac.

From the enlarged opercular summit of the blastostyle there extends into the interior of the gonophore a variable number of cœcal tubes. Some of these are in the form of short, simple, cylindrical processes, while others extend to a greater distance, become more or less branched, and may be traced in contact with the inner surface of the walls of the capsule to within a short distance of the attached end of the gonophore. Brown corpuscles, similar to those in the interior of the blastostyle and cœnosarc, may occasionally be seen in active motion within these cœca.

The sporosac originates as a lateral bud from the blastostyle, and contains a large, simple spadix, surrounded by the ova or spermatozoa.

The generative elements, however, are not confined to the sporosac. In the blastostyle itself numerous ova may be detected; but these are always smaller, and evidently less mature, than those in the sporosac. They are produced in the walls of the blastostyle, apparently between the endoderm and ectoderm, and are very minute towards the summit of the blastostyle, but gradually increase in size towards the point of attachment of the sporosac, and are probably thence conveyed into the cavity of the latter, where a further development awaits them.

In the condition now described, the gonophore continues during the early part of the season; but at a later period there makes its appearance in the female gonophores a spherical acrocyst, in which the ova undergo further development previously to escaping as ciliated embryos.

The young gonophore has the form of a compressed cone attached by its narrow end to the branch, and with its free end wide and slightly concave. In this state it is merely an offset from the cœnosarc of the branch, hollowed out into a cavity, which is only an extension of the common cœnosarcal cavity, and having a delicate chitinous polypary moulded over its surface.

Plumularia falcata, Linn.

The gonophores in this species are of an oval form, with a tubular apical orifice, which is closed by an opercular fleshy plug.

They commence as a minute bud, which soon presents the form of a little inverted cone, having its axis traversed by a blastostyle, which dilates at the wide or distal extremity of the cone into a hollow opercular enlargement. From the blastostyle a single sporosac is produced as a lateral bud, which ultimately, by the arrest of that portion of the blastostyle between it and the operculum, acquires a terminal position, being now supported on the summit of a very short peduncle which springs from the base of the gonophore, and which is nothing more than the proximal extremity of the original blastostyle. From this point the sporosac extends towards the summit of the gonophore, which has acquired an oval form, and which at last it completely fills. From the cavity of the opercular body which closes the summit of the gonophore several more or less branched cœcal tubes are given off into the interior of the gonophore, where they may be seen running for some distance along the inner surface of its walls towards its attached extremity.

The generative elements are produced, as usual, between the ectoderm and endoderm of the manubrium of the sporosac; and by their increase of volume, and consequent pressure, occasion, at least in the female sporosacs, the gradual absorption of the spadix, which is ultimately represented by a small irregular tubercle in the bottom of the sac.

The germinal vesicle and spot are very distinct in the young ova, and the spermatozoa present the usual form of caudate corpuscles. The larva is a ciliated, leucophrydiform body.

Laomedea flexuosa, Hincks.

The usual conformation of the gonophores, and their contents, have been described in the former paper; but there still remains to be considered a remarkable modification of the reproductive system in this species.

We not unfrequently find, especially in specimens gathered late in the season, that on the summit of the capsule, and altogether external to its cavity, there are borne certain peculiar sporosacs, with a structure presenting some interesting points of difference from that of the ordinary or intra-capsular sporosacs.

It was to these extra-capsular sporosacs as occurring in *L. flexuosa,** that Loven long ago called attention, when he supported and developed the doctrine just then announced by Ehrenberg, of the sexuality of polypes, a doctrine which, though in its mode of statement not absolutely correct, was nevertheless full of significance.

The extra-capsular sporosacs, with their investing ectotheque, are attached by a short peduncle to the summit of the blastostyle, where the latter expands into a sort of operculum for the capsule. Two or three of them, in different stages of development, may generally be seen on a single capsule. They are nearly spherical bodies, and contain either a variable number of ova, or else a mass of spermatozoa, the generative elements in either case surrounding a central spadix. The ectotheque contains thread-cells, and there is developed from this membrane, upon the summit of the sporosac, a little crown of short cylindrical processes like rudimental tentacula. The whole body bears thus a resemblance, by no means remote, to a medusa with the opening of its umbrella contracted; but I could never find in it

* The species on which Loven's observations were made is named by him *Campanularia geniculata.* His figures, however, are undoubtedly those of *Laomedea flexuosa,* whose distinctness from *Campanularia* (or Laomedea) *geniculata* of Linnæus has been fully proved by Dr Johnston, and from *L. gelatinosa* of Pallas, with which Johnston confounded it, by Mr Hincks.

the four radiating canals described by Loven, nor any other representative of the gastrovascular system of a medusa. When the contents have attained a sufficient degree of maturity they escape, as has been already shown by Loven, through an aperture which makes its appearance in the centre of the tentacular crown.

If we follow the development of these extra-capsular sporosacs, we shall find, as Loven has already pointed out, that they are originally produced within the capsule. They are here indistinguishable from the ordinary intra-capsular sporosacs, and originate, exactly like the latter, as buds from the blastostyle. The blastostyle, however, instead of remaining stationary, as in the ordinary gonophores, grows upwards through the aperture of the capsule, carrying out with it the most mature sporosacs, or those which are formed nearest its summit, and which thus become extra-capsular, developing from their ectotheque, while in this situation, their little tentacular crown, and, after the discharge of their contents, withering away, to be replaced by others.

Notwithstanding the resemblance which the extra-capsular sporosacs, with their investing ectotheque, bear to a medusa, they will far more easily admit of a comparison with the ordinary intra-capsular sporosacs. Of the two membranes composing their walls, the internal is undoubtedly the endotheque, while the external is just as obviously an ectotheque, differing, however, from that of an ordinary sporosac, in its being provided, for the liberation of its contents, with a definite orifice surrounded by rudimental tentacles.

We have not here, more than in the intra-capsular sporosacs, any representative of an umbrella; and I confess myself quite unable to understand the radiating canals figured and described by Loven. If this excellent zoologist has not been deceived as to the existence of such canals, they will probably be identical with the cœcal processes from the spadix which I have already described as occurring in the sporosacs of several species of hydroid zoophytes.

Sertularia tamarisca, Linn.

Sertularia tamarisca, like most of the hydroid zoophytes, is strictly diœcious, but it further presents the remarkable character of having its male and female gonophores totally different from one another in form, an important fact as regards the zoographical characterization of the species.

The male gonophores appear to be those figured by Ellis in his description of this species. They are very much compressed, somewhat obcordate bodies, with a short tubular aperture.

The female gonophores are far less simple in form. They are oval for about the proximal half of their length, and then become trihedral, with the sides diverging as they pass upwards, while the whole is terminated by a three-sided pyramid. The sides of the pyramid are cut into two or three short teeth along their edges, and each of their basal angles is prolonged into a short spine.

The trihedral portion, with its pyramidal summit, is formed of three leaflets, which merely touch one another by their edges, without adhering, so that they may be easily separated by the needle. They consist of the same chitinous material as that which invests the rest of the gonophore, formed originally, doubtless, upon the surface of an ectodermal lamina.

The male gonophore is traversed by a blastostyle, which gives origin to one or more lateral sporosacs containing the spermatogenous tissue surrounding a large spadix from which no gastro-vascular cœca are developed. The spermatozoa are unusually large, and their body, instead of presenting the more common spherical or pyramidal form, is in the shape of an elongated cylinder, with the caudal filament projecting from one end.

On laying open the female gonophore, we find that the oval or proximal portion of it is occupied by a blastostyle, which gives origin to one or more sporosacs with well developed spadix, and entirely resembling the male sporosac, except in the nature of their contents, which are here ova instead of spermatozoa.

The oval portion of the gonophore terminates upwards by closing round the distal extremity of the blastostyle, which it here encircles with a ring furnished with tooth-like processes. This oval portion constitutes the *proper capsule* of the gonophore, and is the only portion developed in the male. From the summit of the blastostyle, and apparently communicating with its cavity, several irregularly-branched cœcal tubes are given off. They lie altogether external to the proper capsule, and embrace a delicate sac, within which are one or more ova in a more advanced stage of development than that presented by the ova which are still within the capsule. These extra-capsular ova are each enveloped in a special sac, very delicate and structureless, which is continued by a narrow neck towards the summit of the blastostyle, but I failed in my attempts to trace its connections beyond this point.

The extra-capsular ova, with their investing sacs, and the surrounding cœcal tubes, would thus lie entirely exposed, were it not that they are protected by the three leaflets already mentioned as constituting the trihedral portion of the gonophore. These leaflets are given off from the external surface of the oval portion, or proper capsule, near its summit, and, being in contact by their edges, completely enclose a space which is occupied by the structures just described.

Though I have not succeeded in discovering the exact connection between the common extra-capsular ovigerous sac and the structures in the interior of the capsule, nor the precise mode by which the ova gain access to it, I have no hesitation in viewing it as a true acrocyst in which the ova undergo a further development, previously to their liberation as free embryos.

In the following three species, the gonophores contained in all the specimens I examined, *medusæ*, and never sporosacs. These medusæ have been more or less investigated by Van Beneden, Gegenbaur, Dalyell, Gosse, Hincks, Wright, and other observers, and I here give the results of my own independent examinations, as partly confirmatory of the observations of these naturalists, and as partly supplementary to them.

Eudendrium ramosum, Van Beneden.

I obtained this species in fine condition, attached to an old buoy in the harbour of Derryquin, on the Kenmare River, County Kerry, in September 1858.

The gonophores are *simple*, and are borne upon the ultimate ramuli, where they may be seen springing from the upper and lateral surfaces of the ramulus along its whole length. They are obovate, or fig-shaped bodies, each supported on a distinct peduncle, and invested by a delicate chitinous extension of the polypary.

When the gonophore reaches maturity, the ectotheque and its chitinous investment become ruptured at the summit, to allow of the escape of the medusa as an independent free-swimming zooid.

The medusa, on escaping, is provided with a deep umbrella, which measures about $\frac{1}{20}$ of an inch across its base, where it is furnished with a well-developed velum.

The manubrium is of moderate size. It is a sub-cylindrical body, somewhat dilated at its base, and having its oral extremity surrounded by four short tentacles. These manubrial tentacles have the cells of their endoderm so disposed as to give rise to the appearance of a transverse segmentation of their cavity, and the extremity of each is surrounded by a little capitate group of thread-cells. The cavity of the manubrium is lined with cells containing red granules.

From the base of the manubrium four gastrovascular canals radiate towards the margin of the umbrella, to open there into a distinct circular canal.

At each of the four points where the radiating canals open into the circular canal, is a large bulbous dilatation of the gastrovascular system. Its cavity contains red pigment granules, and while at its proximal side it is in communication with the radiating and circular canals, it sends off from its distal side two filiform contractile tentacula; the margin of the umbrella being thus furnished with eight tentacles, arranged in four equidistant groups of two each. At the root of every tentacle is a black "eye-speck." The velum is moderately developed.

From an ordinary-sized specimen of this eudendrium, kept alive in an 8 oz. phial of sea-water, the medusæ were thrown off in such multitudes as to give a milky cloudiness to the water. They continued active with me for more than a week; but during that time no further change of form occurred, and no generative elements were developed in them.*

If we endeavour to trace the development of the gonophore from its earliest appearance to the complete formation of the medusa, we shall find that it originates as a minute solid bud from the side of the branch. In this bud a cavity may be seen communicating with the cavity of the cœnosarc, from which it thus forms a simple *diverticulum.* We next find that the bud has become differentiated into a peripheral and a central portion, the latter containing the diverticulum from the cavity of the cœnosarc. A further differentiation is soon seen in the central portion, which is now manifestly composed of two layers,—an ectoderm and an endoderm,—while the peripheral portion becomes enveloped externally by a delicate chitinous investment. This peripheral portion is to become the ectotheque of the simple gonophore.

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* Gegenbaur has already referred the medusal genus, *Bougainvillea,* to eudendrium as its "nurse" form, and it is evident that the little medusa here described needs only that the number of tentacles and ocelli composing each marginal group shall become multiplied, and the oral tentacles become bifurcated, in order that it may be converted into a true Bougainvillea. This change I have not witnessed, for my continued observation of the medusæ was here interrupted; but Dr Strethill Wright, who obtained the same species of eudendrium in the Firth of Forth, informs me that he has traced its medusæ into the adult Bougainvillea, with the generative elements developed in the base of the manubrium, as is well known to be their situation in this genus.

From the summit of the central portion, which will afterwards become elongated into the manubrium of the medusa, four thick cylindrical cœca may be now seen to be given off; their cavities are simple continuations of the diverticulum, and they extend, with their sides in close contact with one another, towards the distal extremity of the gonophore. They are at first mere tubercles, but they gradually increase in length, becoming developed quite in the same way as the tentacles on the ordinary alimentary polype. After they have attained a certain length, the gonophore continuing at the same time to grow larger, they became separated from one another laterally, and the intervening spaces are now seen to be occupied by a web-like membrane, which extends from the base of the cœca to within a short distance of their extremities, and here terminates by a defined margin.

This membrane is composed of transversely elongated cells, and is plainly a lateral extension of the ectoderm of the cœca. Close to its free margin a narrow tube may be seen extending transversely between the four cœca, connecting them together, and becoming more and more elongated as the cœca continue to separate from one another.

In the four cœca it is now easy to recognise the radiating canals of the gastrovascular system of the developing medusa, and in the transverse tube, the circular canal of this system, while the connecting membrane is plainly the rudimental umbrella.

The distal extremities of the cœcal tubes project slightly beyond the margin of the umbrella, and here become dilated into bulbous terminations, which converge towards the axis of the gonophore, where they lie in contact with one another, and soon become very conspicuous by the accumulation in them of red pigment. From each bulb two short tentacles may now be seen to sprout, and as these continue to grow longer, they may be seen hanging into the concavity of the umbrella, where they then lie somewhat confusedly within the confined space there alloted to them.

In the meantime, a velum has become developed from the margin of the umbrella, while the central portion of the gonophore containing the diverticulum from the cœnosarc has become elongated between the four radiating canals, and may be seen projecting in the axis of the umbrella, as a wide cœcal process, with distinct ectoderm and endoderm. It is easy to recognise in this process the manubrium of the medusa; an oral aperture soon becomes formed at its extremity, and the little medusa, now expanding the margin of its umbrella, and everting its tentacula, escapes from the confinement of the ectotheque, and enters upon the free phase of its existence.

Laomedea dichotoma, Linn.

Fine specimens of this zoophyte were obtained on the south-coast of Ireland, in the beginning of September, loaded with gonophores, containing medusæ in various stages of maturity. The gonophores are compound, and consist of a blastostyle carrying numerous medusæ, which increase in maturity as they approach the summit of the blastostyle, the whole being invested in an external capsule.

The medusa, on its escape from the capsule, has a thin umbrella, which is capable of passing through almost every degree of convexity, from that of a nearly flat disc to that of a dome, embracing about $\frac{1}{3}$d of a sphere, while it is often completely everted, so as to present the appearance of a wide hand-bell without the clapper, the manubrium then representing the handle of the bell. This last condition is that which it always assumes when swimming, the manubrium being then invariably turned *from* the direction of motion.

The base of the manubrium presents a hemispherical dilatation, and on its free extremity is borne a mouth with four well-developed lobes. Four radiating canals extend from the base of the manubrium to the margin of the umbrella, where they enter a distinct circular canal. The margin of the umbrella carries sixteen filiform tentacula,* one of these tentacula being always situated at each junction of a radiating canal with the circular canal. The tentacles are thickly set with thread-cells, and their cavity presents the septate appearance found generally in the group. Close to the base the ectoderm becomes thicker, and the cavity of the tentacle here loses the appearance of being transversely divided by septa.

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* Eighteen may frequently be counted, but this is probably abnormal.

At the inner side of the base of every second tentacle is situated a sessile "lithocyst"; and at the inner side of the base of *every* tentacle may be seen a transparent oval space, having the appearance of a vesicle. The lithocyst consists of a spherical capsule, with a spherical, highly refractile otolite. No pigment spots occur.

A narrow velum extends round the margin of the umbrella.

Exactly in the middle, between each pair of radiating canals, may often be witnessed an appearance like a bundle of delicate fibres, extending from the base of the manubrium to the marginal canal, where it loses itself, by appearing to break up into its component fibres. I believe this appearance is due to mere folds in the inner surface of the umbrella.*

Towards the end of October I again visited the locality where I had previously obtained the Laomedea in great abundance and perfection, but found nothing but dead specimens, from which the gonophores had all fallen.

Campanularia Johnstoni, Alder.

This species was dredged in September, loaded with gonophores, whose contents were in every instance medusæ.

The gonophores may be described as cask-shaped, or of the form of a regular oval, truncated at both extremities. They are corrugated transversely, so as to present a series of regular rings. They are situated on the creeping stolon of the zoophyte, to which they are attached by a short peduncle. They consist of a blastostyle, with medusal buds and investing capsule, and never carried sporosacs.

The medusa, on escaping from the gonophore, has a diameter of about $\frac{3}{100}$ of an inch. The umbrella is very convex, embracing about two-thirds of a sphere. From the base of the manubrium four radiating canals extend to the margin of the umbrella, to unite with the circular canal, and at each point of union arises a tentacle. The tentacle commences with a wide base, which passes rather abruptly into a very extensile filament, which in its completely contracted state I have always found coiled into a regular spiral. The base of the tentacle presents a large cavity, which communicates freely with the marginal canal of the umbrella.

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* The medusa of *Laomedea dichotoma*, as here described, is probably only the young state of Gegenbaur's *Eucope polystyla* (Zeit. f. Wiss. Zool. Band. 8), a species which this naturalist informs us he has traced to the gonophores of one of the campanularidæ.

Between each of the four tentacles are two lithocysts. They consist each of a spherical transparent colourless vesicle, containing a spherical highly refractile otolite, which is itself immediately invested by a very delicate vesicle, of which it looks like the nucleus. Between each lithocyst the margin of the umbrella is extended into a slight projection, having all the characters of a rudimental tentacle.

There is a very wide velum, and in both it and the umbrella muscular bundles are largely developed.

In no instance were generative sacs developed in the specimens which came under my examination. Gegenbaur, however, has found them well developed on the course of the radiating canals in certain species of his genus *Eucope*, a genus to which he would refer all such forms as those here described in *Laomedea dichotoma*, and *Campanularia Johnstoni*, and which, he tells us, he has traced to gemmation from the Campanularidæ. In the undoubted medusæ of *Campanularia Johnstoni*, they have been seen in a similar situation, but not fully determined, by Mr Gosse, while the detection in them of distinctly formed ova by Mr Hincks, and more especially by Dr S. Wright, who has figured and described them, has so far completed the observations needed on this point.

General Conclusions.

To the general conclusions contained in the previous paper, the following generalizations may now be added.

Besides the ordinary development of the ova in intra-capsular sporosacs, we find,

1. That in certain species bearing capsular gonophores (*Sertularia polyzonias*, &c.) the ova, after attaining in the interior of the capsule a definite stage of development, are transmitted into an extracapsular sac (*acrocyst*), where they undergo a further development previously to their liberation as free embryos, and that this sac is formed (at least in the species where its connections were most satisfactorily traced) by a hernial protrusion of the endotheque (and ectotheque ?) of an intra-capsular sporosac through the summit of the capsule.

2. That in certain other species (*Campanularia flexuosa*, &c.) the final development of the ovum, previously to liberation, takes place in a peculiarly formed medusa-like *extra-capsular sporosac*, which, however, must not be confounded with a true medusal zooid. It originates as an ordinary intra-capsular sporosac, and subsequently becomes extra-capsular by the elongation of the blastostyle.

The most important steps in the development of the true medusal buds are the following :—

(1.) The formation of a hollow process from the cœnosarc or blastostyle. (2.) The differentiation in this process, of a peripheral portion (ectotheque), and a central portion (manubruim) ; the latter becoming further differentiated into two layers, ectoderm and endoderm. (3.) The emission from the hollow central portion of four cœcal tubes (radiating canals), composed of ectoderm and endoderm, which, simultaneously with their elongation, have their ectodermal layer expanded into a web-like membrane (umbrella), connecting the tubes laterally with one another. (4.) The further connection of the radiating tubes with one another by lateral branches (circular canal), and the development of a velum from the margin of the umbrella.

From the above processes, it follows that the development of the medusa admits of an easy comparison with that of the alimentary polype, the radiating canals being developed from the central manubrium in the medusa, exactly as the tentacula are from the body of the polype ; but that, while in the polype they continue free, in the medusa they are united laterally by an extension of the ectoderm and by lateral branches.*

A comparison of the two kinds of reproductive zooids (sporosacs and medusa) and of the alimentary zooid (polype) results in the following parallelism :—

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* In the remarkable species, *Laomedea acuminata* (Alder), the tentacles of the polype are actually united, as Mr Alder has shown, for a considerable distance from their origin, by an intervening membrane.

SCHEME OF HOMOLOGOUS PARTS.

MEDUSA.	SPOROSAC.	POLYPE.
Ectotheque,	Ectotheque,	0
Manubrium,	Endotheque + Spadix	Body of Polype.
Ectoderm* of Manubrium confining the generative elements (Medusa of *Tubularidæ*),	Endotheque,	Ectoderm of Body.
Generative Elements [in walls of Manubrium (Medusa of *Tubularidæ*); in walls of Radiating canals (Medusa of *Campanularidæ*)],†	Generative Elements,	0
Endoderm of Manubrium surrounded by the generative elements (Medusa of *Tubularidæ*),	Spadix,	Endoderm of Body.
Umbrella,	0	0
Radiating canals,	Cœcal processes from Spadix,	Tentacles (posterior tentacles in Tubularia).
Circular canal,	0	0
Marginal tentacles,	0	0
Velum,	0	0
Mouth,	0	Mouth.
Oral tentacles,	0	Oral tentacles (Tubularia).

Cœnosarc.

A Statical Barometer, on Father Secchi's principle, was exhibited by Professor Forbes.

The Following Donations to the Library were announced :—

Proceedings of the Royal Society, London. Vol. IX., No. 31. 8vo.—*From the Society.*

The Twenty-fifth Annual Report of the Royal Cornwall Polytechnic Society, 1857. 8vo.—*From the Society.*

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* Professor Huxley's important demonstration of the composition of the proper radiata out of two membranes, must be carefully borne in mind in all our attempts to establish relations of homology in this group.

† It is highly probable that the medusæ whenever produced among the Tubularidæ, will be found to have their generative elements formed between the endoderm and ectoderm of the manubrium ; while, on the other hand, in the medusæ of the Campanularidæ and Sertularidæ, the generative elements will originate in the walls of the radiating canals, here also between endoderm and ectoderm. In the former, therefore, the medusæ would approach the type of *Sarsia,* in the latter that of *Thaumantias,* or more exactly that of *Eucope,* Gegenb. Perhaps, however, until a greater number of instances are accumulated, it would be hardly safe to insist on the validity of this generalization.

Journal of the Statistical Society of London. Vol. XXI., parts 2 and 3. 8vo.—*From the Society.*

Proceedings of the Royal Medical and Chirurgical Society of London. Vol. II., No. 2. 8vo.—*From the Society.*

Proceedings of the Zoological Society. Nos. 349—361. 8vo.—*From the Society.*

Memoirs of the Literary and Philosophical Society of Manchester. Vol. XIV. 8vo.—*From the Society.*

Journal of the Royal Geographical Society. Vol. XXVII. 8vo.—*From the Society.*

Proceedings of the Royal Geographical Society. Vol. II., Nos. 3, 4, and 5. 8vo.—*From the Society.*

Notices of the Proceedings of the Royal Institution of Great Britain. Part VIII. 8vo.—*From the Institution.*

List of the Members, Officers, &c., of the Royal Institution of Great Britain for 1857. 8vo.—*From the Institution.*

The Quarterly Journal of the Chemical Society. No. XLII. 8vo. —*From the Society.*

Journal of the Geological Society of Dublin. Vol. VIII., part I. 8vo.—*From the Society.*

Proceedings of the Literary and Philosophical Society of Liverpool. No. 12. 8vo.—*From the Society.*

Journal of the Proceedings of the Linnean Society. Vol. II., No. 8; Vol. III., Nos. 9 and 10. 8vo.—*From the Society.*

The Quarterly Journal of the Geological Society. Nos. 54, 55, and 56.—*From the Society.*

Journal of the Royal Dublin Society. Vol. I. 8vo.—*From the Society.*

The Journal of Agriculture, and the Transactions of the Highland and Agricultural Society of Scotland. No. 62. 8vo.—*From the Society.*

The Assurance Magazine and Journal of the Institute of Actuaries. Nos. 32 and 33. 8vo.—*From the Institute.*

List of Members of the Institute of Actuaries, 1858–59. 8vo.—*From the Institute.*

The Canadian Journal of Industry, Science, and Art. Nos. 15 to 17. 8vo.—*From the Canadian Institute.*

The American Journal of Science and Arts. Nos. 75 to 77. 8vo. —*From the Editors.*

Madras Journal of Literature and Science. Vol. III., No. 6. 8vo. —*From the Madras Literary Society.*

The Atlantis: A Register of Literature and Science. No. 2. 8vo. —*From the Editors.*

Proceedings of the Academy of the Natural Sciences of Philadelphia. From April 7, 1857, to April 27, 1858. 8vo.—*From the Academy.*

Notice of some Remarks by the late Mr Hugh Miller. By Mr W. P. Foulke. 8vo.—*From the Author.*

Reports on the Meteorology of Scotland for 1857. 8vo.—*From the Meteorological Society.*

Address to the Meteorological Society of Scotland. By Jas. Stark, M.D. 8vo.—*From the Author.*

Translation from the Dutch Pamphlets on Herring Fisheries. 8vo. —*From Dr Hunter.*

Journal of the Asiatic Society of Bengal. Nos. 264, 266, and 267. 8vo.—*From the Society.*

History of Scientific Ideas. By Wm. Whewell, D.D. Vols. I. and II. 8vo.—*From the Author.*

Canal and River Engineering. By David Stevenson, F.R.S.E. 8vo.—*From the Author.*

Notes on the prior Existence of the Castor Fiber in Scotland. By Charles Wilson, M.D. 8vo.—*From the Author.*

Reports of Continental Children's Hospitals. 8vo.

A Treatise on Light, Vision, and Colours. By Thos. Bett, Esq. 8vo.—*From the Author.*

Der Naturen Bloeme, van Jacob van Maerlant. 8vo.

Rhymbal von Jacob van Maerlant: Erste Deel. 8vo.

Bulletin de la Société Impériale des Naturalistes de Moscou. Nos. 1 to 4. 8vo.—*From the Society.*

Compte Rendu de l'Académie Impériale des Sciences de St Petersbourg. 1856. 8vo.—*From the Academy.*

Mittheilungen der Naturforschenden Gesellschaft in Bern. Nos. 360 to 407. 8vo.—*From the Society.*

Verhandlungen der Schweizerischen naturforschenden Gesellschaft in Basil. 1856. 8vo.—*From the Society.*

Bulletin de la Société Vaudoise de Sciences Naturelles. Tome V. Bulletins 41 et 42. 8vo.—*From the Society.*

Bulletin de la Société de Geographie, Paris. Tomes 14 et 15. 8vo.—*From the Society.*

Verslagen en Mededeelingen der Köninklijke Akademie van Wetenschappen, Amsterdam. Afdeeling Natuurkunde, Deel VII. 8vo. Afdeeling Letterkunde, Deel III. 8vo.—*From the Academy.*

Variations Annuelles et Horaires des Instruments Météorologiques a Bruxelles. Par M. Quetelet. 8vo.—*From the Author.*

Observations des Passages de la Lune et des Étoiles de même culmination. Par M. Quetelet. 8vo.—*From the same.*

Composition de l'Atmosphère. Par M. Lamont. 8vo.—*From M. Quetelet.*

Rapport sur l'Etat et les Travaux de l'Observatoire Royal, pendant l'Année 1856. Par M. Quetelet. 8vo.—*From the same.*

Eclipse de Soleil du 15 Mars 1858. Par M. Quetelet. 8vo.—*From the same.*

Catalogues van de Bockerij du Koninklijke Akademie van Wetenschappen, Amsterdam. Deel I. 8vo.—*From the Academy.*

Jaarboek van de Koninklijke Akademie van Wetenschappen, Amsterdam. 1857–8. 8vo.—*From the same.*

Bibliografia Italiana delle Scienze Mediche Serie Prima. Vol. Primo. 8vo.

Rendiconto delle Sessioni dell' Accademia delle Scienze dell' Istituto di Bológna. 1855–6. 8vo.—*From the Academy.*

Die Fortschritte der Physik in Jahr, 1855. Dargestellt von der Physikalischen Gesellschaft zu Berlin. 8vo.—*From the Society.*

Jahresbericht ühn die Fortschritte der reinen, Pharmaceutischen und technischen Chemie, Physik, Mineralogie, und Geologie.—Chemie und verwandter Theile anderen Wissenschaften von Hermann Kopp und Henrich Will.—Physik von Fredrich Zamminer. Für 1857. Register zu den Berichten für 1847 bis 1856. 8vo.—*From the Editors.*

Publications of the Dépôt Général de la Marine:—

Collection of Charts.

Erreurs des compas dues aux attractions locales a Bord des Navires en Bois et en Fer. Par M. Darondeau. 8vo.

Supplement au Catalogue Chronologique des cartes. Plans, Vues de Côtes, &c. 8vo.

Manuel de la Navigation dans le Detroit de Gibraltar. Par Dumolin et de Kerhallet. 8vo.

Reconnaissance Hydrographique des Côtes occidentales du Centre Amerique, Province de Veraquas (Nouvelli Grenada). Par M. De Rosencoat. 8vo.

Note sur les Courants de l'Ocean Atlantique entre l'Equateur et le 10^{e} degré de latitude N. Par M. Lefebvre. 8vo.

Supplement au Livre des Pharas. Par M. Le Gros. 8vo.

Annales Hydrographiques. Vol. XIII. 8vo.

Notes sur la Navigation de L'Archipel des Marquises. Par M. Jouan. 8vo.

Instruction a Levivre pour allier mouller sur la Rade de Santa Cruz. 8vo.

Annuaire des Maries des Côtes de France, pour 1858. Par M. Chazallon. 32mo.

Annaes des Sciencias e Lettras publicados debaixo dos auspicios da Academia Real das Sciencias.—Sciencias Mathematicas Physicas, Historico-Naturaes, e Medicas. Vol. I., Nos. 1–7. Sciencias Moraes e Politicas, e Bellas Lettras. Vol. I., Nos. 1–5. Noticias para a Historia e Geografia das Nações Ultramarinas. Tomo VI. 8vo.—*From the Academy.*

Berichte über de Verhandlungen der Königlich Sächsischen Gesellschaft der Wissenschaften zu Leipsig. Philologisch Historiche Classe. 1856, III. and IV.; 1857, I. and II.; 1858, I.—Mathematische, Physiche Classe. 1857, II. and III.; 1858, I. 8vo.—*From the Society.*

Bulletin de l'Academie Royale de Belgique. II. Series. Tomes I., II., and III. 8vo.—*From the Academy.*

Mémoires Couronnés et Autres Mémoires. Tome VII. Publies par l'Académie Royale de Belgique. 8vo.—*From the same.*

Annuaire de l'Académie Royale de Belgique. 1858. 8vo.—*From the same.*

Annuaire de l'Observatoire Royal de Bruxelles. Par M. Quetelet. 1858. 32mo.—*From the Author.*

Annales de l'Observatoire Royal de Bruxelles. Par M. Quetelet. Tome XII. 4to.—*From the same.*

Observations des Phénomènes Periodiques. 4to.—*From the same.*

Jahrbuch du Kaiserlich-Koniglichen Geologischen Reichsanstatt. Wien. 1857. N^{ro}. 2, 3, and 4. 8vo.—*From the Institution.*

Monatsbericht der Königlichen Preuss. Akademie der Wissenschaften zu Berlin. Januar, Februar, März, April, Mai, Juni, 1858.—*From the Academy.*

Geological and Topographical Map of London and its Environs. By R. W. Milne, F.R.S. 8vo.—*From the Author.*

Collection of Maps of the Basin of La Plata, &c. By Thomas J. Page, U.S. Navy.—*From the Author.*

Explanations and Sailing Directions to accompany the Wind and Current Charts. By M. F. Maury, LL.D., U.S. Navy. Vol. I. 4to.—*From the Author.*

Report of Progress 1853–56 of Geological Survey of Canada. 8vo. —*From Sir W. E. Logan.*

Plans of Lakes and Rivers between Lake Huron and the River Ottawa, to accompany the Geological Reports. 4to.—*From the same.*

Memoirs and Papers of Hugh E. Strickland, M.A. By Sir W. Jardine, Bart. 8vo.—*From the Author.*

Astronomical and Meteorological Observations made at the Radcliffe Observatory, Oxford, in 1856. Vol. XVII. 8vo.—*From the Radcliffe Trustees.*

Neue Denkschriften der Allgemeinen Schweizerischen Gesellschaft für die gesammten Naturwissenschaften. Zurich. Band XV. 4to.—*From the Society.*

The Habeeb-os-Seear. By Mirza Gheeos-od-Deen bin Mirza Hamaeem-od-Deen. Being a General History of the World from the Earliest Times to the Year of the Hijira 930., A.D. 1520. 2 vols. 4to.—*From* ALI MUHAMMED KHAN, *Consul of the Ottoman Porte at Bombay.*

Compte-Rendu Annuel. Par A. T. Kupffer. Année 1856. 4to.—*From the Author.*

Memorie della Reale Accademia delle Scienze de Torino. Tome XVII. 4to.—*From the Academy.*

Sulle Forme Cristalline di Alcuni Sali di Platino e del Boro Adamantino. Per Q. Sella. 4to.—*From the Author.*

Sulle Forme Cristalline del Boro Adamantino. 2do. Memoria. Per Q. Sella. 4to.—*From the same.*

List of Members, Report of Council, &c., of the Royal Institute of British Architects. 1858. 4to.—*From the Institute.*

Verhandlingen du Koninklijke Akademie van Wetenschappen. Amsterdam. Deels. IV, V., and VI. 4to.—*From the Academy.*

Flora Batava. Part 183. 4to.—*From the King of Holland.*

Observations on the Genus Unio. By Isaac Lee, LL.D. Vol. VI. Part I. 4to.—*From the Author.*

Judicial Statistics, 1857, England and Wales.—Police, Criminal Proceedings, Prisons; Common Law, Equity, Civil and Common Law. 4to.—*From the Secretary of State for the Home Department.*

Meteorological Tables of the Board of Trade. Nos. I., II., and III. 4to.—*From the Board.*

Report on the Meteorological Department of the Board of Trade. 1858. 8vo.—*From the same.*

Barometer and Weather Guides. By R. Adon. Fitzroy. 8vo.—*From the same.*

Transactions of the Society of Antiquaries of London. Vol. XXXVII., No. 2. 4to.—*From the Society.*

Proceedings of the Society of Antiquaries of London. Vol. IV., No. 47. 8vo.—*From the same.*

List of Members of the Society of Antiquaries of London for 1858. 8vo.—*From the same.*

Observations Météorologiques Faites à Nijné-Taguilsk. Resumé des Dix Années 1845–54; et Année 1855; et Année 1856. 8vo.

Danzigs Handels und Gewerbsgeschichte unter dur Herrschaft des Deutschen Ordens. Von du Theodor Hirsch. 8vo.—*From the Royal Saxon Society of Science of Leipsic.*

Elektrische Untersuchungen. Zweite Abhandlung: über die Thermo-Elektrischen Eigenschaften des Boracites. 1857. 8vo.—*From the same.*

Elektrische Untersuchungen. Dritte Abhandlung: über Elektricitäts; erregung Zwischen Metallen und erhitzten Salzen. 1858 8vo.—*From the same.*

Nouveau Principe sur la Distribution des Tensions dans les Systèmes Élastiques. Par M. L. F. Ménabria. 4to.—*From the Author.*

Archives de Museum d'Histoire Naturelle. Tome X. Liv$^{\text{ons}}$ I. et II. 4to.

Den Magnetische Inclinations Forandringer i den Nordlige og Sudlige Halvkugle. Af Christopher Hansteen. 4to.—*From the Author.*

Astronomical, Magnetical, and Meteorological Observations made at the Greenwich Observatory. 1856. 4to.—*From the Royal Society.*

Magnetical and Meteorological Observations made at Bombay Observatory. 1856. 4to.—*From the East India Company.*

Abhandlungen du Königlichen Gesellschaft du Wissenschaften zu Göttingen. Band VII. 1856–7.—*From the Society.*

Abhandlungen du Königlichen Akademie du Wissenschaften zu Berlin. 1857.—*From the Academy.*

Compendio Storico della Scuola Anatomica di Bologna. Scritto da Michele Medici. Folio.—*From the Author.*

Rendiconto della Societa Reale Borbonica. Anno V. 4to. Napoli.—*From the Society.*

Memorie della Reale Accademia delle Scienze. Napoli. Vol. I., 1852–54; Vol. II., 1855–57. 4to.—*From the Academy.*

Account of the Principal Triangulation, and of the Figure, Dimensions, and Mean Specific Gravity of the Earth, as derived therefrom. By Captain A. R. Clarke, of the Ordnance Survey. 4to.—*From the Secretary of State for War.*

Details au Sujet de la Formation des Oolites Calcaires. Par M. J. Fournet. 8vo.—*From the Author.*

Index Map to the Ordnance Survey of England and Wales.—*From the Board of Ordinance.*

Compte-Rendu de l'Académie Imperiale des Science de St Petersbourg. 1857.—*From the Academy.*

Abhandlungen, Herausgegeben von der Senkenbergischen Naturforschenden Gesellschaft. Band II., Lief. 92.—*From the Society.*

Engravings of the Ganglia and Nerves of the Uterus and Heart. By Robert Lee, M.D., F.R.S. 8vo.—*From the Author.*

Proceedings of the Royal Geographical Society of London. Vol. II., No. 6. 8vo.—*From the Society.*

Transactions of the Cambridge Philosophical Society. Vol. X., Part I. 8vo.—*From the Society.*

Monday, 20th December 1858.

Professor CHRISTISON, V.P., in the Chair.

The following Communications were read:—

1. On the First Properties of Matter—Inertia, Gravitation, Elasticity—referred to a common Law. By John G. Macvicar, D.D. Communicated by Professor Fraser.

The author commences by a vindication of the Scottish philosophy, that he may legitimately build upon *substance* as a reality as well as *phenomenon*. He then shows that just as the idea of substance presents, *a priori*, an alternative, viz., those which are wholly fixed, the subject of law imposed from without only, and those which possess a power of changing their mode of being from within themselves; so, in point of fact, common observation has recognised in all ages two orders of substances or beings characterized by this difference, and filling up in the sphere of reality this alternative given by pure thought; the one being the ground of all natural phenomena, and ordinarily designated *body;* the other the ground of all moral and intellectual phenomena, and designated *spirit.*

Of Body the most characteristic properties are inertia, gravitation, and elasticity; and these are still regarded in science merely as postulates, and that, unrelated to each other except as properties inhering in the same subject; just as heat, electricity, magnetism, and chemical affinity were some years ago. It is the attempt to show the homogeneity of this group of properties, and to account for them, that has given its title to this communication.

For this purpose the author lays hold of *The Law of Assimilation,* already admitted in physiology; he shows that it operates in nature far more extensively than is generally supposed; in fact, he affirms that it is universal, and the only law of nature that needs to be considered by us for the explanation of phenomena. This law, when thus conceived in its utmost generality, he thus expresses:—"Everything *tends* to assimilate itself to itself in successive moments of its existence; and *extends* this action to all things around to unknown distances, assimilating them also more or less to itself, meanwhile being of course more or less assimilated to them in its turn." And hence, all through nature, at once the permanence and intransmutability of species, whether organized or molecular, and the construction of these species into genera or groups into which the same type enters.

His first application of this law is to show the genesis of inertia. Thus, let any portion or particle of substance considered merely as such be subject to this law alone, it follows, that in its relations both to space and time, that portion or particle must assimilate itself to itself in every successive moment; that is, if it be at rest it must continue at rest, and if it be in motion it must, in every successive moment, accomplish the same element of motion which it accomplished in the first; whence it is obvious that its motion must be uniform and rectilinear, and must continue so till it be changed from without. But this is simply a definition of inertia, whose genesis thus appears.

Similarly he shows, that if the portion or particle of substance be considered, not in reference to its *matter* but its *form*, it must, under the law of assimilation, tend to maintain its true volume and form, and, to restore it when it has been disturbed—it must be resilient and elastic.

Again, let there be two or more particles or masses (each and all of which must thus be inert, and in their last elements elastic also), and let them be placed in different regions of space; it follows, that though as to inertia and elasticity they are identical already, and the law of assimilation has exhausted itself upon them as substances and forms, yet they are not assimilated as to the spaces they occupy. This, therefore, the law of assimilation must tend to effect. Under this law they must tend towards one place. Moreover, in being assimilated as to place, they must also be assimilated as to time. In a word, they must tend to move, and that simultaneously, towards one another, each assimilating the other as to the place which it occupies, or attracting it with a force proportional to itself (its quantity of substance, mass, or inertia). Nor is it merely the fact of mutual attraction that follows from the law of assimilation, but also the law of that attraction. Thus, considered as an attractive apparatus, it must be conceived as investing in a spherical manner the attracting particle. Now, the law of assimilation requires, with respect to such a spherical investiture, that all the successive spherical shells or superficies, of which the entire sphere of attraction may be conceived to consist, must in attractive value be assimilated to each other; that is, they must all be equal to each other. But in quantity or extent they vary as the squares of their distances from the centre. Estimated, therefore, not as to the entire superficies, but along any line or radius, the attractive force must vary inversely as the square of the distance or radius; which is the well-known law of gravitation. Thus the genesis at once of inertia, elasticity, and gravitation is given. They are shown to be homogeneous in their nature, and not occult properties inhering in matter, but merely uniform phenomena arising from the operation in different circumstances of one and the same law.

The author then proceeds to show, that the law of assimilation also gives a definite conception as to the structure of least parts of matter in the last analysis which nature appears to permit or accomplish. He is thus led to infer the existence of an universal ether or medium of light. And from this, to the molecules of bodies, he thinks that a transition may be made, by regarding the latter as products of the former; the ethereal elements being definitely grouped into molecules; which, under the law of assimilation, must be symmetrical, and permanent or intransmutable (except in long epochs), as also ever bent on union with one another, wherever there is a difference between them; and their union would not occasion too great a degradation of the symmetry which each possessed when existing separately.

2. On the Structure and Functions of the Branchial Sac of the Simple Ascidiæ. By Andrew Murray, Esq.

The chief portion of this paper is occupied with an inquiry into the truth of Milne Edwards' theory, that the branchial sac of the Ascidians is perforated throughout by apertures, or what he called branchial stigmata.

Some experiments and observations made by Mr Murray last season had induced him to regard this view with doubt. In considering the question, he first examined the evidence that was recorded in support of it. Putting aside those writers who had taken M. Edwards' theory on trust, he could only find four observers who seem to have critically tested it, viz.,—Dr Lister, with whom the idea originated: who, while stating that the walls of the sac appeared to be traversed by open spaces, yet states that at times he thought he saw something like a veil stretching across them, and that the particles in suspension in the water were observed to course past these spaces without entering; which would appear to be inconsistent with the idea of the water entering, for the course of the water, and of the particles floating in it, must necessarily be the same. The next author was Milne Edwards, who announced the open passages as a fact, without going into any reasoning or proof upon it. He however started with a bias; for he alludes at the outset to Dr Lister having established the fact, which, it will be observed, is stating the results of his observations much too strongly. M. Coste followed, and took the directly opposed view, holding that the branchial spaces were all closed by a more or less diaphanous membrane. Van Beneden seems to have halted between the two opinions. But Huxley, the last and most formidable of them all, takes Edwards' idea up *in toto*, and has informed Mr Murray, that he thinks he has seen the currents of water passing through the stigmata in at least two *Ascidiæ*, viz., *Perophora*, and *Appendicularia.*

Mr Murray's observations consisted in feeding the Ascidiæ with coloured sea water, in injecting them, and in actual examination of their structure. In those fed with indigo, the coloured material was never found on the exterior of the sac, but always deposited on its inner wall. Injection by the mouth into the sac failed to push the injection through its walls except by rupturing them. Mr Murray thought that, under a high power of the microscope, a diaphanous membrane was to be seen stretching across the branchial stigmata; but if so, the membrane was so thin as to be scarcely perceptible.

According to Mr Murray, the mode in which the water which enters at the oral aperture passes to the anal aperture would therefore appear to be still unknown.

Mr Murray narrated, also, his dissections of the ciliated sac or valvular aperture which lies at the top of the dorsal fold, which at one time he had been disposed to think (with the elder Carus) might furnish a mode of egress, but satisfied himself that it was rather a blind sac, or at least a sac terminating in a very small bloodvessel.

In the course of his investigations Mr Murray made the curious discovery, that in *Phallusia Virginea* the chylaqueous fluid is strongly acid. He had not found this quality in any other species which he had yet examined, but he thought it probable it might be found in *P. Mentula*, *P. Oblonga*, and those other species which are allied to *P. Virginea.*

Another observation made by Mr Murray in relation to this matter, and one which promises to furnish interesting results, was, that in none of the mollusca (and indeed in none of the invertebrate animals) on which his experiments had been made, was the food digested by gastric acid. He had never found acid in the stomach. The mode of digestion in the invertebrata would appear therefore to be probably conducted on a different system from that in the vertebrata.

Incidentally Mr Murray alluded to the Notodelphs and small crustacea found in the stomachs of Ascidiæ. He differed from those authors who thought them parasitic, as he had found many dead, and in all stages of apparent digestion, in the respiratory sac of *Phallusia Virginea.*

With regard to the homology of the parts in question, he pointed out that the facts he had brought forward all tended to show that the sac is homological with the pharynx rather than with the tentacular crown of the Polyzoa.

The following Donations to the Library were announced:—

Quarterly Journal of the Chirurgical Society, No. XLIII. 8vo.—*From the Society.*

Bulletin de la Société Impériale des Naturalistes des Moscou. 1857, Nos. II., III., and IV. 1858, No. I. 8vo.—*From the Society.*

Transactions of the Pathological Society of London. Vol. IX. 8vo.—*From the Society.*

Schriften der Universität zu Kiel. 1856, Band III. 1857, Band IV. 4to.—*From the University.*

Journal of the Statistical Society of London. Vol. XXI. Part IV. Dec. 1858. 8vo.—*From the Society.*

Memoirs of the Literary and Philosophical Society of Manchester. Vol. XV. Part I. 8vo.—*From the Society.*

Proceedings of the Literary and Philosophical Society. 8vo. Nos. 1 to 14. 8vo.—*From the same.*

Eight Maps of Hindostan. Nos. 24, 38, 54, 73, 102, 103, 111, and 112.—*From the East India House.*

An Account of Some Recent Researches near Cairo, undertaken with the view of throwing light upon the Geological History of the Alluvial Land of Egypt. Instituted by Leonard Horner, Esq. 4to.—*From the Author.*

Proceedings of the Zoological Society of London, 162 to 169. 8vo. —*From the Society.*

Transactions of the Zoological Society of London. Vol. IV. Part V. 4to.—*From the same.*

77 New Charts, 4 Corrected Charts, and 15 Books and Pamphlets. —*From the Admiralty.*

Notice of two new Maximum and Minimum Thermometers, by the Rev. J. G. Macvicar, D.D. of Moffat.—*From the Author.*

Monday, 3d January 1859.

PROFESSOR KELLAND, Vice-President, in the Chair.

The following Communications were read:—

1. Note on certain Vibrations produced by Electricity. By Professor Forbes.

"In the course of last summer (1858) I became acquainted with a phenomenon described by Mr Gore in the Philosophical Magazine for June (Supplement, p. 519), of the following nature:—A metal cylinder, supported on two metallic rods or rails, the latter being in connection respectively with the poles of a battery, revolves in either direction, at will, under the action of an electric current copious in quantity. Also continuous rotation of a light copper ball, supported on two circular metallic rails, takes place in either direction at pleasure, depending on the first impulse. It appeared to me very probable that this interesting fact might be applied to explain what is still obscure in the experiment on heated metals, generally known as the "Trevelyan Experiment," described by Mr Trevelyan, in the "Edinburgh Transactions," vol. xii., where there is also a paper by myself on the same subject. With a view to elucidate the experiment, I had Mr Gore's circular railway and ball constructed some months since by Mr Kemp. I had not an opportunity of seeing it tried until October 19th, when I found it to answer well, with four

Bunsen's pairs connected for quantity. The same day, in Mr Kemp's laboratory, I laid a brass "Trevelyan" bar or rocker on the edge of the brass plate, forming the outer rail of Mr Gore's machine, and connecting the rail with one pole of the same battery, and the bar (by means of a globule of mercury inserted in a cavity in its upper surface) with the other, energetic vibrations commenced quite resembling those occasioned by heat in the ordinary form of the experiment on a leaden support.

"I have since found, among other results,—1. That the vibration goes on in whichever direction the electric current passes. [At first I thought that there was a superior effect when the current passed from a good to an imperfect conductor, but this has not been confirmed, as far at least as I have gone]. 2. The vibrations take place both between metals of the same kind and heterogeneous metals. 3. When heat is applied to a brass bar vibrating on cold lead, and then electricity is applied as before, the effects are superadded to one another whichever way the current passes, the vibrations becoming more energetic, and if there be a musical note it becomes graver [owing, it is assumed, to the increased arc of vibration]. 4. When a bar of brass was placed so as to vibrate on two parallel upright plates, also of brass, respectively connected with the poles of a battery, the vibrations continued, when the whole was immersed partly or wholly in water, and even when *flooded* by a powerful continued stream of cold water from a five-eighth inch pipe under considerable pressure. From this experiment I conclude that the effect of the heat developed by the electrical current in the thin upright plates may be fairly considered to be reduced so low as to be incapable of producing a sensible result (if such were ever the case). Indeed, allowing for the resistance and friction of the water tending to diminish the vibration, there is no ground for thinking that the action was less energetic in the one case than in the other. It is consequently reasonable to conclude that the effect in question is due to the repulsive action of the electricity in passing from one conducting body to another, and not to its effect in producing expansion.

"Now this is precisely the effect which I attributed to heat in the paper of 1833 already referred to. I therefore consider it a strong confirmation of the opinion I then expressed, from which I have never swerved, although it has not in general been received with much favour. The importance which I attach to this new confirmation, and the suggestiveness of Mr Gore's experiment on the rolling-ball, will be judged of from the fact, that in 1833, or earlier, I had an apparatus made, consisting of a bar resembling Mr Trevelyan's, but longitudinally divided by a non-conducting partition, while the two conducting sides were furnished with mercury cups for connecting them with the poles of a battery, the circuit being completed through the metallic base. The instrument exists, or existed a few years ago, though I am at present unable to find it. As well as I recollect, it was tried with an old-fashioned Cruickshank's battery of fifty pairs, without success. Indeed, I now find that, even with modern appliances, the experiment does not succeed when the circuit is only closed whilst *both* points of bearing of the rocker touch the mass or support.

"20th December 1858."

"Since the date of the preceding notice (which was prepared for being laid on the table of the Royal Society at their meeting on the 20th ult.), I have continued and extended these experiments. As they are still in progress, I will content myself with mentioning two results as worthy of notice. I have obtained very active vibrations of carbon (such as is used in one of the elements of Bunsen's battery) resting upon brass, and also when it rests upon two pieces of carbon connected with the terminals of a battery. For this purpose, a battery having a certain amount of intensity is requisite, in order to overcome the resistance of carbon as a conductor, but the vibrations are most energetic. The extremely small expansion which takes place in carbon by heat is another argument against that view of the Trevelyan experiment. The other experiment to which I refer is, that bismuth (and perhaps other metals) are not merely inactive as vibrators with any electric power which I have used, but the passage of electricity through them appears to have a *quelling* power which brings the rocker to instantaneous rest; yet bismuth permits a far freer passage of electricity than carbon: in one experiment I found that sixteen times as much was conducted. Something analogous was formerly observed by me in connection with heat applied to bismuth. I am now attempting to investigate the subject farther by experiment.

"3d January 1859."

2. On the Temperature of the Sea around the Coasts of Scotland during the years 1857 and 1858; and the bearing of the facts on the Gulf-stream Theory. By James Stark, M.D., F.R.S.E., &c.

By a reference to observations made on the temperature of the air, of the sea, and the solid land, the author showed that the mean temperature of each of these in and around Scotland were within the fraction of a degree of each other. From observations made on the temperature of the air and of the sea at stations on the west coast, he showed that not only did the air and sea attain their respective minima and maxima at the same time, but that even in their fluctuations of temperature they bore a distinct accord with each other. He then pointed out that such fluctuations in the temperature of the sea were quite fatal to the theory of the mild winters of Britain being dependent on the influence of the Gulf-stream, as such fluctuations could not occur were the temperature of the sea dependent on the heated waters of the Gulf-stream. From a variety of considerations he therefore endeavoured to demonstrate that the mild winters of Britain were due to the south, south-west, and west winds, which are the prevalent aerial currents which pass over Britain during the winter season.

He then examined the whole evidence brought forward by Maury and others for the Gulf-stream flowing up through the North Atlantic to Britain and the North Seas, and by a reference to a number of well ascertained facts, demonstrated that the Gulf-stream has no such course; but that, on the other hand, it is, on the east of the great Newfoundland Bank, deflected southwards by the great Arctic current, and is lost in that great calm mass of waters, the Sargasso Sea, which exists in the centre of the Atlantic.

He then pointed out the course of the currents in the North Atlantic Ocean. He showed that though a small portion of the Arctic current flows through the Gulf of St Lawrence, while another portion flows towards the American coasts, washing the southern shores of Newfoundland and Nova Scotia, that the chief portion of that current crosses the Atlantic towards the western shores of Europe and Africa. That the upper part of this current entering the Bay of Biscay, washes round it, giving rise to the current known as Rennell's current, which as it leaves the Bay of Biscay crosses the mouth of the English Channel, and flows up both sides of Ireland. That the middle portion of the Arctic current flows through the Straits of Gibraltar to supply the wastes in the Mediterranean Sea. And that the southern, and probably the greater portion of this Arctic current, rushing towards the north-west coast of Africa, gives rise to that current so much dreaded by mariners, and known by the name of the North African current.

He then showed that neither the Gulf-stream, nor any other current in the North Atlantic, took their direction in consequence of any influence of the rotation of the earth on its axis; and pointed out the fact, that the direction of the equatorial current, of the Gulf-stream as it issues from the Gulf of Florida, and of the Arctic current as it crosses to Western Europe and Africa, are all opposed to such a supposition.

He also showed that the Gulf-stream is bent back on the curved coasts of Florida by the greater force of that portion of the Equatorial current which flows to the north of St Domingo and Cuba, and meeting the smaller stream which issues from the Gulf of Mexico, forces it back on the Florida coast. He also showed that the eastward course of the Gulf-stream was given by the curved coasts of Florida, Georgia, and the two Carolinas.

The author then referred to Commander Becher's bottle-chart as fully corroborating his views of the course of the currents in the North Atlantic, and pointed out many facts, proved by that valuable chart, which were quite opposed to and inexplicable by the theory that the Gulf-stream flows onwards towards Britain.

The different specific gravities of the Arctic current and of the Gulf-stream, the density of the sea-water on our western shores during summer and winter, the existence of the telegraph plateau between Newfoundland and Ireland, the finding in the mud brought up from it volcanic ashes identical with those from Iceland, and the known limits of the whalebone and spermaceti whales, were all referred to as corroborative of the views of the author.

Dr Stark then summed up by showing the bearing of all the facts he had stated on the question as to what caused the mildness of Britain's winters, and showed that they all corroborated the conclusion that the south-west winds were the agents by which this was effected. He showed that the only countries of Europe which could be materially benefited by these winds were the south of Spain, Portugal, Britain, and Norway; while France, from lying far back, with the whole peninsula of Spain intervening between these winds and her, experienced to but a trifling extent their heating properties, and consequently, though much further south, had a winter more severe than that in Britain.

The following Gentlemen were duly elected Ordinary Fellows of the Society:—

William F. Skene, Esq.
G. W. Hay, Esq.
Robert Russell, Esq.
Dr Fayrer.
George Robertson, Esq.
Dr Lyon Playfair, C.B.

The following Donations to the Library were announced:—

The Lithology of Edinburgh, by Rev. John Fleming, D.D., F R.S.E. With a Memoir by the Rev. John Duns, Torphichen. 8vo.—*From the Publisher.*

Annales de l'Observatoire Physique Central de Russie. Anna 1855. Nos. 1 and 2. 4to.—*From the Russian Government.*

Medico-Chirurgical Transactions. Vol. xli. 8vo.—*From the Royal Medical and Chirurgical Society of London.*

Journal of Agriculture and Transactions of the Highland and Agricultural Society of Scotland. No. 63. 8vo.—*From Highland Society.*

Nyt Magazin for Naturvidenskaberne. Udgives af den physiographiske Forenung i Christiania ved M. Sars og Th. Kjerulf. Tiende Binds förte Heft. 8vo.—*From Royal University of Norway, Christiania.*

Norges Historie i Kortfattet Udtog af P. A. Munch. Fierde Udgave. 8vo.—*From the same.*

Gamle Norske Folkeviser Udg. af Sopus Bugge. 8vo.—*From the same.*

Kortfattet Beiledning af M. G. Fletting. 8vo.—*From the same.*

Norges Gamle Love, indtil 1387. Ved R. Keyser og P. A. Munch 1, 2, and 3 Binds. Folio.—*From the Royal Society of Drontheim.*

Det Norske Sprogs vaesentligste Ordforrand Sammenlignet nud Sanskrit, &c. Af Chr. A. Holmboc. 8vo.—*From the same.*

Monday, 17*th January* 1859.

Professor CHRISTISON, Vice-President, in the Chair.

The following Communications were read :—

1. Notice of a Shower of "a Sulphurous Substance" (so-called), which fell in Inverness-shire in June 1858. By John Davy, M.D., F.R.S., London and Edinburgh, &c.

This shower took place about the 10th of June. The following account of it is from the *Inverness Courier;* and, as showing the interest the phenomenon excited, it was republished in most of the English papers. The copy I give is from the *Spectator* of the 3d July.

" After the late thunder-storm, a deposit resembling sulphur was observed in several places in this neighbourhood (Inverness). At Freeburn it lay on the road and grass in some places to a depth of nearly half an inch. At Craigton Cottage, near Kissock, the deposit was observed on the top of water caught in a cask from the roof of the house, like a thick cream. The sulphurous substance was skimmed off, and dried in a piece of flannel. When dry it was a fine powder, and when thrown into the fire ignited exactly like gunpowder, making a slight fizzing noise. Unfortunately none was preserved beyond what was experimented on in this way. A boat at Craigton was powdered all over with the same substance; and a countryman living on the heights near Kilmuir, says, that near his house, in the space of what an ordinary washing-tub would cover, he could lift the powder with a spoon. The heavy rains have since washed it all away."

This account, so far as mere appearances are concerned, I believe to be trustworthy; I can in part confirm it, as it happened that on the very day, the 10th of June, I was *en route* for Inverness by the mail, proceeding by the upper Highland road. Just after crossing the Spey at Kingussie, the substance in question was seen, both on the road and by the road-side. It was in such abundance that the guard had no difficulty in collecting a quantity of it during the few seconds that the coach was stopped for the purpose. Of what was then gathered I obtained a portion, which, on my return home, I examined.

The results, as might be expected, proved that the substance was not sulphur, nor of a sulphureous nature, but a vegetable matter, the pollen of the fir—*Pinus sylvestris*, a tree of which there are extensive forests on the banks of the Spey. Before the blow-pipe, it burnt with flame, without the slightest sulphureous odour; and left a little charcoal, which, when consumed, yielded a minute quantity of ash, possessed of an alkaline reaction. When first inflamed it made no such noise as that mentioned in the newspaper; nor in burning did it in the least resemble gunpowder. If thrown on the fire before it was quite dry, the noise described in that notice might have been owing to the sudden conversion of the moisture into steam, producing a slight crepitation. Under the microscope it was found to consist of grains, some of a spherical form, others, and those of largest size, of the same form, with, as it were, a lateral addition, as if a smaller grain were attached, or as if the pollen grain had been ruptured at opposite points, and a protrusion of some of its contents had taken place.* The diameter of a single grain was about $\frac{1}{1070}$th of an inch. The central part of those supposed to be ruptured was commonly transparent, and exhibited a delicate granular structure, which was rendered slightly brown by the action of iodine. The lateral protuberances were more or less opaque.

Comparing the substance under consideration with the pollen of the Scotch fir, taken fresh from the tree, I find there is a perfect resemblance in form and colour and other properties. Further, in corroboration, it may be mentioned, that at the time of the occurrence of the shower, this fir was in flower in the Highlands very generally; and it is well known that when ripe, as it was at the time specified, it is apt to be shaken off by gusts of wind and rain in extraordinary quantities, so as to produce what have been called "sulphur-showers." By Sir John Richardson I have been informed that it is not uncommon to see the surface of the great lakes in Canada covered with a thick scum of the same kind in the vicinity of pine forests.

What renders the event, as it took place in the Highlands, remarkable, and no doubt rare there, is the extent of ground over which the pollen fell, and the quantity of it that was deposited.* It is worthy of notice, that this year the flowering of all our plants has been astonishingly abundant. This circumstance may account for the quantity; and the rareness of the phenomenon may be owing to the circumstances essential to its taking place seldom coming together, such as the incident of a thunder-storm with rain just at the time that the pollen is ripe for dispersion.

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* In the pollen of the Scotch fir we find, that by the increase of the intine the extine is separated into two hemispherical portions, marked by the dark spaces at each end of the grains.—*Edit. R. S. Proc.*

In the annals of the dark ages showers are recorded of a singular kind: in those of Ireland, for instance, as detailed in the last valuable census of that country, mention is made of those "of blood," of "a butter-like substance," &c.; and, analagous to that in Inverness-shire, "of a shower of a yellowish substance which resembled brimstone." This last mentioned is recorded as having "fallen in and about the town of Doneraile," in 1748.

In conclusion, I would beg to observe, that I have been particular in the account of this pollen shower, with the hope of showing that an occurrence vaguely reported, assuming, from the manner in which it has been described by eye witnesses, a perplexing and mysterious character, when examined with the smallest aids afforded by science, loses those qualities, and appears perfectly natural. And, I would add, can it be doubted, that had other showers, such as the reported ones of blood, &c., been in the same manner investigated, the result would have been similar; and in the place of a marvel, we should have had recorded an interesting, and it may have been an instructive fact. Such phenomena might perhaps, in particular cases, serve a part to the naturalist akin to that of coins and other remains of art to the antiquarian, and lead to inferences in the science of the former hardly less certain and valuable than those derivable from the latter in civil history. I venture to give an instance in illustration. After finding the substance in question the pollen of the fir, it occurred to me as probable that the fir might be common in that part of Ireland where, according to the annals, the shower of a yellow substance resembling sulphur fell; and I learn that it is so. In a letter with which I have been favoured by Mr Wilde, the compiler of the annals, to whom I applied for information, he says,—"I have just seen a person from Doneraile, who informs me, that it is the most thickly wooded part of the county of Cork, and that the timber there is chiefly pine."

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* The names of the places given in the newspapers where the pollen was observed denote, it will probably be admitted, the great extent of surface over which the shower spread. Craigton Cottage and Kilmuir are, I am informed, two miles from Inverness, about eighteen miles from Freeburn, and Kilmuir is about forty-four miles from Kingussie; that is by the mail-road, but no more than thirty-three in a straight line due south.

2. Some Remarks on the Roman Edition of the Vatican Manuscript. By the Rev. Dr Robert Lee.

Dr Lee commenced with a general account of the existing MSS. of the Greek Scriptures, and particularly of the Uncial MSS. These, though few in number in comparison of the Cursive MSS., are of peculiar value, on account of their greater antiquity and the superior purity of their text. Fac-similes of several of the most important of these interesting documents were exhibited. After making some remarks upon the Alexandrian, the Ephraem, the Beza, and Clermont MSS., Dr Lee remarked that all of these were now, and most of them had long been, available to Biblical scholars by means of the excellent copies which had been issued, the possessors of the documents having afforded every facility and encouragement. The only exception was the Vatican MS., of which he had now to speak, and which had hitherto been withheld from inspection, for reasons which might be guessed but could not be justified. He then proceeded to describe this Codex, chiefly from the accounts of Hug and Tischendorff, concluding, with them, that its age could not be later than the fifth, perhaps not later than the fourth century. The lately issued Roman edition was then considered. The prefaces threw no light upon the delay and obstruction which had occurred—they spoke much, indeed, on the subject, but really said nothing. Dr Lee censured this work on several grounds. 1. Because it wanted Prolegomena, which, in this case, were necessary, and, indeed, indispensable—the more so as the jealousy of the authorities at the Vatican had prevented free access to those who were desirous to examine the Codex. 2. Because the work was gone about in a way which could not but produce manifold mistakes and *maculæ*, which had accordingly been produced. 3. Because the title gave a false description of the Book, which was not "The Old and New Testament according to the Vatican Manuscript," as the title held forth, but the Greek Scriptures from the Vatican MS., and from various other MSS. of different and often uncertain date, of inferior authority, but all far more modern. Not only are the defects of the MS., such as the first forty-seven chapters of Genesis, the Apocalypse, and other smaller defects supplied—excusably, if not commendably—but large masses of matter, which never formed any part of the original document, are arbitrarily inserted—such as the rejected version of Daniel, and the whole four books of the Maccabees; so that the work is rendered enormously voluminous and expensive by the accumulation of matter which has no title to be there, and which is no of value whatever in a critical point of view. But what Dr Lee considered the gravest of the sins with which this expensive edition was chargeable, was the insertion, for dogmatic and ecclesiastical reasons, of those spurious or doubtful passages in the New Testament which are wanting in the Vatican and the other most ancient authorities. Such are Mark xvi. 9–20, Luke xxii. 43, 44, John viii. 1–11, and particularly 1 John v. 7. The editor treated these omissions as if they were defects in his MS.; whereas these passages were insertions—*i. e.*, corruptions introduced into later documents. What made the matter worse was, that in other cases in which the Vatican Codex wanted matter found in the common Greek text, it was omitted by Cardinal A. Mai; such as the Doxology to the Lord's Prayer, Matthew vi. 13, also Matthew xxiii. 14, Acts xxiv. 7, 8, without any reason being assigned, or even any notice taken. This different proceeding in different cases might be considered mere carelessness or accident by those who did not know that the passages arbitrarily introduced had the support of the Latin Vulgate, while those left out wanted that support. For all the three omitted passages before noticed were wanting in that version—the first in all the editions and MSS., the other two in its oldest and best MSS. This was denounced as flagrant partiality. In short (Dr Lee concluded), men who are committed to certain versions and texts, and to certain ecclesiastical systems and interests, have nothing to do to be editing such works as this. They can hardly afford to be quite candid or perfectly honest; and though they were, they can hardly expect to get credit for these virtues. The book which costs nine pounds is, for critical purposes—the only purposes for which it was wanted—not worth nine shillings. Williams and Norgate's reprint of the New Testament part—the only part which is of any importance—is to cost about this moderate sum, and it will possess all the utility and value of the five huge quartos.

3. On the Constitution of Flame. By Mr Swan.

In this communication the author discusses the theory of the constitution of flame advanced by Professor Draper of New York, in his paper "On the Production of Light by Chemical Action," which appeared in the *Philosophical Magazine* for 1848.

Professor Draper refers to experiments which prove that the higher the temperature of an incandescent body, the more refrangible are the rays of light emitted by it. He assumes that the temperature of the outer portions of a flame is greater than that of the interior regions; for outside there is a better supply of oxygen, and hence a more intense combustion is maintained. He thence argues that a flame must consist of a series of layers of different colours following the order of tints in the prismatic spectrum, the red being innermost and the violet outermost. Professor Draper conceives that he has demonstrated by experiment that such a structure actually exists in flame.

Mr Swan, on a careful examination of various flames conducted essentially according to Professor Draper's methods of observation, with the exception of one particular in which that observer's process seemed objectionable, completely failed to verify his results; and on the following grounds believes his views regarding the constitution of flame to be erroneous:—

1*st*, Professor Draper's method of observation, so far as it can be gathered from his somewhat imperfect account of it, involves an error in principle calculated to lead to fallacious results.

2*d*, His theory is founded on the quite gratuitous assumption of a great diversity of temperature between portions of flame so closely contiguous, as to render the existence of such diversity of temperature highly improbable.

3*d*, Even although great diversity of temperature did exist in different portions of a flame, there is no reason to believe that it would give rise to a series of layers of different colours. As the temperature of an incandescent body is raised, rays of continually higher refrangibility are, doubtless, emitted; but these are in every case accompanied by rays of *low* refrangibility. From this it follows that the outer regions of a flame, however high their temperature, will not yield *exclusively* the extreme violet rays of the spectrum, as Professor Draper supposes, but will equally emit the extreme *red* rays. The inference, therefore, regarding the colours of the different regions of a flame which Professor Draper has drawn from their assumed diversity of temperature, is obviously inadmissible.

The following Gentlemen were duly elected Ordinary Fellows of the Society:—

Dr JOHN BROWN, F.R.C.P.
Professor RICHARDSON of Durham.

The following Donations to the Library were announced:—

On the Currents of the Ocean. By James D. Dana. 8vo.—*From the Author.*

Review of Marcon's Geology of North America. By James D. Dana. 8vo.—*From the same.*

Francesca da Rimini, her Lament and Vindication. By H. C. Barlow, M.D. 8vo.—*From the Author.*

Physikalske Meddelelser ved Adam Arndtsen. 4to.—*From the Royal University of Norway, Christiania.*

Nyt Magazin for Naturvidenskaberne, ved M. Sars og Th. Kjerulf. 10de Binds, 2 det og, 3 die Hefte. 8vo.—*From the same.*

Om Piperviken og Ruselókbakken. Ved Gilert Sundt. 8vo.—*From the same.*

Ueber das Vorkommen von Quellengebilden in Begleitung des Basaltes der Werra-und Fulda-Gegendender. Von Joh. F. L. Hausmann. 4to.—*From the Author.*

Ueber den Einfluss der Beschaffenheiten du Gesteine auf die Architektur. Von J. F. L. Hausmann. 4to.—*From the Author.*

Oversigt over det Kongelige danske Videnskabernes Selskabs Forhandlinger. Aaret 1857. 8vo.—*From the Society.*

Nachrichten von der Georg-Augusts-Universität und der Königl. Gesellschaft der Wissenschaften zu Göttingen. 1857. 8vo. —*From the Royal Society of Gottingen.*

Acta Academiæ C. L. C. Naturæ Curiosorum. Vol. XXIII., Suppl.; Vol. XXVI., Part 1. 4to.—*From the Academy.*

Kongliga Svenska Vetenskaps-Akademiens Hanlingar. Första Bandet, Andra Häftet, 1856. 4to.—*From the Academy.*

Ofversigt af Kongl. Vetenskaps-Akademiens Forhandlingar. 1857. 8vo.—*From the same.*

Berättelse om Framstegen i Fysik under är 1852. Af E. Edlund. 8vo.—*From the same.*

Kongliga Svenska Fregatten Eugenies Resa Omkring Jorden under befäl af C. A. Virgin. Aren, 1851–1853. Häft 1–5. 4to. —*From the same.*

Journal of the Royal Dublin Society, Nos. 9–11. 8vo.—*From the Society.*

The Assurance Magazine and Journal of the Institute of Actuaries, No. 34.—*From the Institute.*

Meteorologische Beobachtungen aufgezeichnet an der Konigl. Sternwarte bei Munchen in den Jahren, 1825–37. 8vo.—*From the Royal Observatory of Munich.*

Annalen der Königl. Sternwarte bei Munchen. 10 Band. 8vo.—*From the same.*

Astronomische Beobachtungen auf der Königl. Universitäts-Sternwarte zu Konigsberg. 33 Abtheilung. Folio.—*From the University.*

Observations on British Zoophytes, Descriptions of New Protozoa and of two Tubicolar Animals. By Dr T. Strethill Wright. 7 Pamphlets. 8vo.—*From the Author.*

Monday, 7th February 1859.

PROFESSOR KELLAND, Vice-President, in the Chair.

The following Communications were read:—

1. Biographical Memoir of the late Dr D. Skene of Aberdeen. By Alex. Thomson, Esq. of Banchory.

This memoir commences by stating that it seemed desirable to arrange and preserve what memorials could still be found of one who had done very much to promote the study of natural science in Scotland, but whose memory had well-nigh perished.

Dr Skene's father and grandfather were both eminent physicians in Aberdeen, where he was born, on 13th August 1731.

His early education was conducted in Aberdeen. He spent the winter of 1751–2 in Edinburgh, attending various medical classes; and in the autumn of 1752 proceeded to London, where he studied under Hunter and Smellie, besides attending several of the hospitals.

In January 1753 he went for a few months to Paris, in order still further to advance his professional studies. Extracts from letters to his family were read, giving vivid and interesting descriptions of men and manners, and especially of his various teachers; of the insolence of the Parisian Perruquiers, and how they obstructed the other students; and of the cost and worthlessness of the Rheims degrees of M.D., the possession of which was concealed by the owner like the commission of a crime.

Dr Skene returned to Aberdeen in the summer of 1753, and on 8th September of that year received the degree of M.D. from King's College and University; and settled permanently as assistant to his father in Aberdeen.

From 1753 to 1765, he carried on his researches in Natural History without aid, except from such books as then existed.* No trace of scientific correspondence has been discovered, until his first letter to Mr Ellis, the well-known writer on corallines, in 1765. From that time to his death he kept up a close correspondence and interchange of specimens with Mr Ellis—discussing particularly, at great length, the whole question of the nature of zoophytes, sponges, and corallines; the correspondence throwing much light on the state of natural science at the time.

In the same year Skene commenced a correspondence with Linnæus; and the original letters of Linnæus were laid on the table, with the scroll-letters of Skene. Skene wrote good Latin, and frankly controverted the opinions of the illustrious Swede on the nature of zoophytes,—maintaining them to be animals,—the constructors of their dwellings, and in opposition to the theory that the dwellings constructed the animals.

During their correspondence, the twelfth edition of the *Systema Naturæ* was in the press, and Skene is repeatedly given as authority by Linnæus. It is evident that he was much pleased with his only Scottish correspondent—" Ubi præter te nullum curiosum novi."

In 1769, Skene began to correspond with Pennant; and a regular correspondence was maintained during the rest of his life. He is frequently quoted in the *Fauna*, prefixed to Lightfoot's *Flora Scotica*.

Several proposals were made to make Skene a professor in Aberdeen, and Glasgow, and Edinburgh, but he showed no great desire to quit his established position in his native town, in many respects well suited to his tastes.

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* The only instructions he had on any branch were during a few weeks' attendance on Dr Alston's Lectures, in the Botanic Garden, Edinburgh.

One correspondence, which was read, laid open a singular negotiation for the *sale* of an Edinburgh Professorship, the most remarkable feature of which was, that none of the parties concerned seem to have had the slightest idea that they were engaged in a most improper transaction.

Among his school correspondents whose letters have been preserved, are to be found Dr Hope, Dr Reid, whose letters to Skene were printed by Sir William Hamilton in his Life of Reid, Mr Walker of Moffat, Lord Kaimes, &c. &c.

Skene was an active member of the Aberdeen Philosophical Society, where he read many papers on a great variety of subjects; and he was also a member of a Musical Society. In 1769 he was admitted a member of the Edinburgh Philosophical Society, but did not contribute any papers.

He died in December 1770, at the early age of 38. He left behind him a very considerable quantity of MSS., embracing, in one form or other, most branches of human knowledge; and the catalogue of his library proves him to have been a very accomplished general scholar.

Several volumes of these papers were laid on the table; the most important of which were three volumes of botanical, zoological, and entomological descriptions; and one containing a "Discourse on the Study of Natural History," on which he had bestowed much pains, as several copies have been found among his papers, in various stages of progress.

Few of his papers are dated, so that it is not easy from them to trace his progress; but much of his knowledge must have been acquired before the commencement of his scientific correspondence, which extends only over the last three or four years of his life. His letters show that he possessed one characteristic of a true naturalist, viz., his willingness to communicate to others whatever facts he had ascertained, and whatever specimens he could collect. Though his early death prevented his publishing, it is very clear that he contemplated the preparation of a complete Fauna and Flora of his own neighbourhood, if not of the whole of Scotland; and it is impossible to say how much natural science in Scotland may have been indebted to him, from the impulse he communicated to all with whom he came in contact.

The memoir concluded by stating, that though the subject could not be very interesting to those devoted to the active study of natural science at the present day, it had its value to those who took pleasure in studying the progress of human knowledge.

2. On a new Arrow-Poison from China. By Dr Christison.

In a newspaper printed at Shanghae, in the spring of 1857, a wonderful account was given of a poison, which was said to be employed in the interior of China for destroying the largest animals. Instant death was said to be produced, when an animal was struck in the trunk of the body with an arrow poisoned with it. Such was its potency, according to the opinion of the Chinese, that a scheme was said to have been set on foot for destroying the British army during the late war, by bringing down to Canton the natives who were in the practice of using it. But the scheme was frustrated by peace being unfortunately proclaimed too soon.

The poison, and apparently the plant also, are known by the Chinese name of *Wu-Tsau*, or Tiger-poison. The author received very lately from Dr Macgowan, an American physician residing at Shanghae, a specimen of the poison, and of the root of the plant from which it is prepared. The root presents all the characters of an *Aconitum* on a very small scale. This corresponds with the conclusion to be drawn from the characters of a few leaves which were also sent, and which scarcely differ from those of *Aconitum ferox*. A farther proof is, that the root produces in an intense degree the very singular combination of numbness and tingling, which is occasioned by chewing the root of any of the active aconites known in Europe, such as *A. Napellus*, *ferox*, *sinense*, or *uncinatum*. The poison itself, contained in a little porcelain bottle, is obviously a very well prepared extract; and, if not entirely composed of the extract of the wu-tsau root, at all events must contain it largely, for a very minute quantity produces the most intense tingling and numbness of the tongue and lips after it is chewed.

There can be no doubt, therefore, that the wu-tsau poison must be extremely energetic. But the author objected to the admission that either this or any other arrow-poison can produce instant death, as is often stated by travellers. Every poison, however energetic, must be absorbed into the blood before it can act. Even from a wound, absorption cannot take place suddenly. Some time is required before enough can enter the blood. When death takes place instantly, the cause must be the mechanical violence inflicted by the arrow. The author exhibited various poison-arrows used in different parts of the world, which were adequate to occasion most deadly wounds if they struck the trunk of the body over an important organ; and he also showed that even the little slender wooden poison-darts, used in some parts of the world for destroying birds and small animals, by being shot from a blowing-tube, may be easily projected with a force amply sufficient to kill a small bird or animal by the violence inflicted, apart from the more tardy deleterious influence exerted by the poison.

3. On the Connection between Temperature and Electrical Resistance in the simple Metals. By Balfour Stewart, Esq.

About a fortnight since I mentioned to Professor Forbes that the resistances of the simple metals to the passage of electricity seemed to be very nearly in proportion to their absolute temperature, this relation being especially manifest for those values of the resistances determined by M. Arndtsen.

Professor Forbes informed me that this coincidence had already been observed by Professor Clausius, and that an abstract of his paper was given in the *Philosophical Magazine* for November last. On referring to Professor Clausius's original paper, it would seem that the coincidence had suggested itself to him as a remarkable similarity occurring between the rate of increase (due to temperature) of the electrical resistance of those metals, and that of the volume of a gas under constant pressure. It would seem that the fact was unconnected in his mind with any theoretical considerations.

As, however, I was led to look for and remark the coincidence by theoretical considerations, perhaps this Society will permit me to lay before them a short statement of my views.

The passage of electricity along a wire is generally viewed in the following light:—The free electricity of one particle decomposes the electricity of the particle next it; the two electricities then combine by sparking across the interval; and the same thing is renewed over and over again with extreme rapidity. Now, whether electricity be viewed as a substance or a motion, we may suppose that a polarized state of particles is alternately produced and destroyed with great rapidity while an electrical current passes along a conducting wire.

And by a polarized state of particles we would mean a peculiar disposition with respect to the direction in which the electricity is travelling, of the *matter*, or it may be *motion*, of the particles of the substance.

Again, an idea very generally entertained with regard to heat is, that it consists in a vortical or rotatory motion of the particles of a substance.

Now, with only very general ideas regarding the mode of electrical conduction and the nature of electricity, we may suppose that the polarization which conduction demands will be resisted in proportion to the rotatory energy of the particle; just as a rapidly rotating top or cylinder would resist any attempt to change its plane of motion.

The resistance of a particle to electrical polarization would, therefore, be in proportion to its rotatory *vis viva*—viz., its absolute temperature. This only holds with regard to simple bodies; in compound bodies the passage of electricity may be supposed to be a more complicated phenomenon.

31*st January* 1859.

The following Gentleman was duly elected an Ordinary Fellow of the Society :—

Rev. JOHN DUNS, Torphichen.

The following Donations to the Library were announced :—

Bulletin la Société Vaudoise des Sciences Naturelles. Tome VI. Bulletin, No. 43. 8vo.—*From the Society.*

Catalogue de la Bibliotheque de la Société Vaudoise. 8vo.—*From the Society.*

Almanaque Nautico para 1860, calculado de ōrden de S. M. en el Observatorio de Marina de la Ciudad de San Fernando. 8vo. —*From the Observatory.*

Mémoire sur la Relation des Sources Thermales de Plombières, avec les Filons Metalliferes, et sur la formation contemporaire des Zéolithes. Par M. Daubrée. 8vo.—*From the Author.*

Recherches Experimentales sur le Striage des Roches du au Phénomène Erratique. Par M. Daubrée. 8vo.—*From the Author.*

Observations sur le Métamorphisme. Par M. Daubrée. 8vo.—*From the Author.*

Journal of the Proceedings of the Linnæan Society. Vol. III. No. 11. 8vo.—*From the Society.*

Transactions of the Linnæan Society. Vol. XXII. Part 3. 4to. —*From the Society.*

Transactions of the Historic Society of Lancashire and Cheshire. Vol. X. 8vo.—*From the Society.*

Transactions of the Botanical Society of Edinburgh. Vol. VI. Part 1. 8vo.—*From the Society.*

Atlantis, a Register of Literature and Science, conducted by the Members of the Catholic University of Ireland. No. III. 8vo.—*From the Editors.*

Siluria. By Sir R. I. Murchison. 3d Edition. 8vo.—*From the Author.*

The Canadian Journal of Industry, Science, and Art. Nov. 1858. 8vo.—*From the Canadian Institute.*

The Statistics of Marriage in England. By S. M. Drach. 8vo.—*From the Author.*

Horæ Subsecivæ. Locke and Sydenham, with other occasional papers by John Brown, M.D. 8vo.—*From the Author.*

Proceedings of the Berwickshire Naturalists' Club. Vol. IV., No. 2. 8vo.—*From the Club.*

Monday, 21*st February* 1859.

PROFESSOR CHRISTISON, Vice-President, in the Chair.

The following Communications were read:—

1. Remarks on the Behaviour of Mercury as an Electrode. By T. Strethill Wright, M.D., &c. Communicated by William Swan, Esq. The experiments were shown.

In this paper the author described numerous experiments, serving to show the modification which occurred in the capillary attraction between mercury on the one hand, and various saline and acid fluids forming parts of active voltaic circles on the other. He also described and showed to the Society the undulatory motions which he had observed in mercury, when forming the cathode of a constant voltaic current in solutions of chloride of sodium, containing small quantities of sulphuric acid.

2. On the Natural History of the Herring. By J. M. Mitchell, Esq. Communicated by Dr Allman.

Before entering on the details of the natural history of the herring, the author points out the great value of the herring-fishery to the maritime nations of Europe ; and quotes various scientific authorities to show, that the herring is superior in economical importance to every other fish. Thus Cuvier, in his work on fishes, edited by Professor Valenciennes, says,—" Les grands politiques, les plus habiles economistes ont vu dans la pêche du hareng la plus importante des expeditions maritimes."

Such views have led the British, Dutch, Swedish, and Norwegian governments, to inquire at present into the natural history, and to legislate regarding the fishery of the herring. The author has described the principal steps taken by these nations, and has given important statistical details of the British herring fishery, showing, that fish, to the value of upwards of a million sterling are annually taken on our coasts.

The high value of the fishery, not only in promoting the welfare of a large portion of our population, but in producing a strong, hardy, and industrious race of fishermen, most valuable to such a maritime nation as Britain, is next referred to.

The author then points out various errors regarding the herring which have been committed in works of high authority, such as Cuvier's work on fishes, already referred to, M'Culloch's Dictionary of Commerce, and the last edition of the Encyclopædia Britannica. He conceives that he has solved the doubtful questions, regarding the natural history of the herring,—an object of the greatest importance, when we consider the high economical value of the fishery. He also points out several new and important facts regarding the appearance of the fish on our coasts. Among others, that the herring swims nearest the surface in dark and mild weather; and nearer the bottom when the weather is bright and cold.

He next enters on the details of the natural history of the herring, describing its characteristics and its distinctive difference from other fishes of its class. The important question of its food, is elaborately examined; and it is shown, as stated to the author by Agassiz, that the herring does not confine itself to one species of food, namely that the food usually consists of minute crustacea; but during the spawning season it feeds on sand-eels, the fry of various fishes, and even its own spawn.

The author has ascertained a new and important fact from personal observation, regarding the cohesion of the spawn, and the power of adhering strongly to substances on which it may be placed, which only takes place on the fecundation of the roe by the milt.

Many writers reiterate the opinion, that the herring is a native of the distant northern seas. This the author shows to be an error, proving that the fish is a permanent inhabitant of our coasts.

He, for the first time, gives a complete description of the visits of the herring, or its geographical and chronological distribution over the surface of the globe, so far as is known; and his work is the first and only one which exhausts the difficult questions which have hitherto arisen regarding the most valuable and important fish, which the bounty of Providence sends to supply food for the human race.

Monday, 7th March 1859.

Professor KELLAND, Vice-President, in the Chair.

The following Communications were read :—

1. Some Inquiries concerning Terrestrial Temperature. By Professor J. D. Forbes.

In this paper the writer starts by assuming Dove's Temperatures for the mean of every 10th parallel of latitude, from 75° N. to 40° S., to be correct. His object is to inquire how far the influence of the proportion of land and water in modifying the annual temperature of a given parallel is susceptible of being reduced to a formula.

The amount of land and water in different latitudes is first tabulated.

It is then shown, from an examination of the ordinary isothermal curves, and also from Dove's charts of the "Thermic Anomaly," that the influence of land is to exalt the temperature of lower latitudes, and to depress that of higher latitudes. About the latitude of 42 °or 43° this influence is *nil;* and the temperature of that parallel is independent of the proportions of land and water. For convenience of calculation, however, the latitude of 45° is assumed as the one free from this anomaly.

The writer shows that the decrement of temperature along an oceanic meridian (that of Greenwich, for example) proceeds nearly as the simple cosine of the latitude (which is Sir D. Brewster's formula); while along a continental meridian (one passing through Siberia) it is more nearly as the square of the cosine (the law of Mayer.)

Hence it is argued that the temperature of any parallel may probably be represented by a formula containing (1) a constant; (2) a term varying with a power of the cosine not differing much from unity; (3) a term for the effect of land, containing as a factor the proportion of land on the parallel, and also the factor cos. $\overline{2 \text{ lat.}}$, which renders it additive below 45°, and subtractive afterwards.

Considering, first, the northern hemisphere alone, the constants are introduced into such a formula by a comparison of the observed temperatures of latitudes 0°, 30°, 50°, and 70°, with the following result :—

$$T_{\lambda} = 12^{\circ}\cdot 5 + 59^{\circ}\cdot 2 \text{ cos. } \tfrac{5}{4}\lambda + 38^{\circ}\cdot 1 \text{ L}' \text{ cos. } \overline{2\,\lambda}$$

where T_{λ} is the temperature of latitude λ on Fahrenheit's scale, and L′ the effective proportion of land in the circumference of that parallel.

The extension of the formula to the southern hemisphere is shown to give satisfactory results, although all merely *empirical* formulæ for the northern hemisphere altogether fail in this case.

Some other and independent confirmations of the formula are then adduced.

Supposing the globe to be entirely composed of land, or entirely of water, the temperature of any parallel may be deduced from the formula. In the case of a globe all land, the Equatorial temperature would be about 110°, and the Polar temperature about −26°; whereas, on an aqueous sphere, the former would be about 72°, and the latter +12°.

2. On the Spermogones and Pycnides of Lichens. By W. Lauder Lindsay, M.D., F.L.S. Communicated by Prof. J. H. Balfour.

The researches contained in the author's memoir, of which the following is a brief abstract, extended over a period of several years, and are based on careful microscopic examination of several thousand specimens of lichens from every part of the known world. The author examined the lichens of the Hookerian Herbarium at Kew, which contains an unrivalled series of specimens collected by the various surveying and exploring expeditions of the British Government, as well as by all the more distinguished modern British travellers. This collection is further valuable, from containing authentic specimens collected and named by Borrer, Turner, Hooker, Brodie, Carmichael, Babington, and other distinguished British lichenologists, as well as by Acharius, Schærer, Swartz, and other continental authors. Access was also had to the Menziesian Herbarium in the University of Edinburgh, the Herbaria of the said University, of the Botanical Society of Edinburgh, of the Museum of Irish

Industry, Dublin, and of Dr Mackay of Dublin, which last contains authentic specimens of the lichens described by Dr Taylor in the "Flora Hibernica." The fasciculi of dried specimens published by Schærer, Hepp, Leighton, and others, as well as large numbers of specimens gathered in, and sent from, various parts of England, Wales, Scotland, and Ireland, were also examined. Besides the examination of dried specimens in herbaria, the author studied lichens extensively in their native habitats on the mountains of Scotland and Norway, and elsewhere.

With the exception of two short memoirs,* already published by the author, the researches in question are the first that have been made on the subject under review in this country. The memoir is essentially organographic, and gives full details of the characters of the spermogones and pycnides of the higher lichens,—that section, namely, which comprises fruticulose, filamentous, and foliaceous species. The genera, whose spermogones and pycnides are described, are:—

1. *Usnea*, Hoffm.
2. *Neuropogon*, Nees and Flot.
3. *Chlorea*, Nyl.
4. *Alectoria*, Ach.
5. *Evernia*, Ach.
6. *Dufourea*, Ach.
7. *Dactylina*, Ach.
8. *Ramalina*, Ach.
9. *Roccella*, Bauh.
10. *Thamnolia*, Ach.
11. *Sphærophoron*, Pers.
12. *Acroscyphus*, Lév.
13. *Stereocaulon*, Schreb.
14. *Bæomyces*, Pers.
15. *Cladonia*, Hoffm.
16. *Umbilicaria*, Hoffm.
17. *Cetraria*, Ach.
18. *Platysma*, Hoffm.
19. *Nephromium*, Nyl.
20. *Peltigera*, Hoffm.
21. *Solorina*, Ach.
22. *Sticta*, Ach.
23. *Ricasolia*, DN.
24. *Parmelia*, Ach.
25. *Physcia*, Fr.
26. *Pyxine*, Fr.
27. *Psoroma*, Fr.
28. *Pannaria*, Del.
29. *Coccocarpia*, Pers.
30. *Amphiloma*, Fr.
31. *Squamaria*, DC.
32. *Placodium*, DC.
33. *Ephebe*, Fr.
34. *Lichina*, Ag.
35. *Synalissa*, DR.
36. *Omphalaria*, DR. and Mont.
37. *Collema*, Ach.
38. *Leptogium*, Fr.
39. *Obryzum*, Wallr.†

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* 1. "Monograph of the Genus *Abrothallus*." Quarterly Journal of Microscopical Science, Jan. 1857. Transactions of British Association for 1856. Botanische Zeitung, Dec. 25, 1857.

2. "On the Structure of *Lecidea lugubris*." Quart. Journ. of Microsc. Science, July 1857.

† The nomenclature and arrangement followed here and in the Memoir is that of Dr Nylander of Paris, as given in his "Synopsis methodica Lichenum omnium hucusque cognitorum." Paris, 1858. Pp. 65.

The crustaceous section of the lichen family has been examined by the author in a similar manner; but the description of the pycnides and spermogones of the lower lichens is reserved for a separate memoir. Neither does he profess to enter upon the *questio vexata* of the physiology of reproduction in lichens generally. To this subject also he proposes devoting a special memoir. The memoir contains, *inter alia*, descriptions of the spermogones, or pycnides, of many species, in which they either have not hitherto been found, or in which they are very rare and difficult of discovery. Such are the spermogones of *Usnea barbata*, *Thamnolia vermicularis*, *Neuropogon melaxanthus*, *Alectoria jubata* and *A. Taylori*, *Evernia furfuracea*, *Lecanora tartarea*, &c. The letter-press of the memoir is accompanied by 16 quarto plates of coloured drawings—amounting to several hundreds—and by specimens of lichens, bearing spermogones or pycnides, amounting to about 140.

Among the more interesting or important general facts brought out by the memoir, may be enumerated the following:—

1. In addition to the sporiferous organs,—so long familiar to botanists,—called *Apothecia*, lichens possess more or less microscopically minute organs, called *Spermogones*. The *latter* organs the author has found alike in species from arctic and antarctic, temperate and equatorial, regions.

2. The spermogones of lichens may concisely be described as follows:—In *form* they are usually more or less spherical or oval, appearing on the surface of the thallus as punctiform or papillæform, wart-like or barrel-shaped, bodies. In *colour* they are usually blackish, brownish, or of divers colours. In *site* they are usually scattered over particular portions of the thallus—seldom generally over its whole surface; they are usually more or less immersed in the tissues of the thallus, sometimes they are sessile on its surface, or on the apices of its ramifications, when it is erect and fruticulose. In *size* they are seldom sufficiently large to be visible to the naked eye, and are frequently so minute that they can, with difficulty, be recognised even with the aid of a good lens. In the latter case, especially, it is advisable or necessary to moisten the thallus in order to render them prominent from the contrast of colour or surface. They consist of a capsule, enclosing a cavity, that opens to the surface by a minute pore or ostiole, which is generally of a darker colour than the said capsule. From the inner wall or surface of the

capsule project, convergently into the cavity, a series of filaments, closely aggregated, called *Sterigmata.* These are either simple, formed of a single elongated cell,—or compound, made up of a series of cells, varying in size and form, superimposed the one upon the other. They produce from their apices, when simple,—from apices and sides, when compound or articulated,—a succession of very minute, solid, homogeneous corpuscles, called *Spermatia.* Just as the importance of the apothecia resides in the spores, so the importance of the spermogones resides in the spermatia. These corpuscles are destitute of any essentially vital motions, though they frequently, from their great tenuity, exhibit Brownian or molecular movements. Nor are they provided with any such appendages as cilia.

3. Spermogones usually occur on the same plant or specimen which bears apothecia: sometimes, however, only on barren plants or specimens. Hence, in regard to apothecia and spermogones, lichens have been described by continental authors as monœcious and diœcious. Again, spermogones occur in some species which never bear apothecia, as in *Thamnolia vermicularis.*

4. Spermogoniferous states of many species are what were regarded by the older lichenologists as separate varieties, species, or even genera, *e. g.*, vars. *encausta* and *vittata* of *Parmelia physodes*, and var. *denticulata* of *Platysma nivalis.* The discovery, therefore, of spermogones and pycnides simplifies lichenology by abolishing certain genera, species, and varieties, and materially reducing the number of names, *e. g.* the old genera *Cliostomum, Thrombium,* and *Pyrenothea,* being found to consist wholly of spermogoniferous states of more familiar lichens, have been abolished.

5. To a certain extent, or with trifling exceptions, just as certain families or genera of lichens are characterised by apothecia and spores of a particular kind, so they are also characterised frequently by spermogones, sterigmata, and spermatia of a particular kind. Thus *Usnea* and *Ramalina* have wart-like spermogones of the same colour with the thallus, and inconspicuous in consequence thereof. The spermogones of *Cladonia* are barrel-shaped, deep brown, and easily visible. Those of *Parmelia* are mostly punctiform, immersed, black or brown, very minute and crowded; those of *Physcia* are mostly papillæform; and those of *Collema* and *Leptogium* discoid, and of a pale brown or yellow colour. In *Sticta, Ricasolia,*

Umbilicaria, *Collema*, *Leptogium*, *Thamnolia*, *Coccocarpia*, and *Placodium*, the sterigmata are articulated, consisting of numerous, short, broadish, frequently thick-walled, cells. They are also articulated or compound,—but the component cellules are few, longish, and delicate,—in *Usnea*, *Neuropogon*, *Parmelia*, *Evernia*, and *Platysma*. They are simple and filiform in *Ramalina*, *Cladonia*, *Ephebe*, and *Lichina*. The spermatia of *Cladonia* and *Roccella* are curved or sickle-shaped. Those of *Squamaria* are very long, slender, and twisted or curved. Those of *Collema*, *Leptogium*, and *Umbilicaria* are short, straight rods; while those of *Ramalina*, *Ephebe*, and *Lichina*, are oblong or oval-oblong.

6. The spermogones sometimes of themselves yield important characters for classification. For instance, the spermogones, sterigmata, and spermatia of *Thamnolia vermicularis* are sufficient of themselves to separate this puzzling lichen from the genus *Cladonia*, in which it has hitherto been almost uniformly placed.

7. Spermogones frequently outwardly resemble, and are therefore apt to be confounded with—

a. Nascent apothecia, as in some *Ricasolias;*
b. Pycnides, described below;
c. Minute *Verrucarias;* or
d. Minute parasitic fungi, chiefly of the genus *Sphæria*.

For instance, the author frequently receives from correspondents as *new Verrucarias* what prove to be merely spermogoniferous states of other lichens. From all the bodies above named, spermogones may at once be distinguished by microscopic examination, and by this alone.

8. The spermogones of lichens are now generally regarded as male organs of reproduction—the spermatia being supposed to be analogous in function to the antherozoids or spermatozoids of other cryptogams, and to be endowed with a fecundating or fertilizing influence on the spores. But it is necessary to state distinctly that this is a mere hypothesis, for direct or distinct proof is still wanting. The following circumstances, however, give great support to this hypothesis, and ought, at all events, to be borne constantly in mind in all speculations on the functions of the spermogones and spermatia:—

a. Intimate relation between the spermogones and apothecia in regard to *site*—the former being generally seated in close proximity to the latter. As illustrations of this intimate relationship, it may be stated that spermogones sometimes occur—

1. In the hypothecial tissue of the apothecium itself, as in *Celidium fusco-purpureum*, Tul. [Mém., Pl. 14., f. 12.]
2. On the apothecium itself, as in *Lichina pygmæa* and *confinis*, and sometimes in *Cladonia rangiferina.*
3. On the exciple of the apothecium, as in *Urceolaria scruposa* and *Parmelia conspersa.*

b. Relative period of development,—the spermogones normally preceding the apothecia. Spermogones should therefore be looked for in specimens bearing no apothecia or young apothecia; when the apothecia are mature, we should expect to find the spermogones old, and perhaps degenerate.

c. Relative abundance of spermatia and spores,—the former being infinitely more numerous than the latter.

d. Relative size of spermatia and spores,—the former being infinitely the smaller.

e. Essential difference in structure between spermatia and spores, the former being solid, simple, or homogeneous, without septa; the latter vesicular, frequently compound or septate, with heterogeneous contents.

f. Essential difference in form, the spermatia being usually elongated and of extreme tenuity, the spores being generally oval or spherical.

g. Greater constancy of size in spermatia than in spores, which are frequently very variable in this respect. Some spermatia are much larger when attached to their sterigmata than when free—as in some *Parmelias;* but this is only an apparent anomaly, for it would appear that they normally split into two on being shed from their sterigmata.

h. Absence of all germinative faculty,—so far as yet known.

i. Similarity in structure between the capsule or envelope of the spermogone and the exciple of the apothecium,—the cellular tissue of which they are composed being generally the same.

k. Constancy of occurrence of spermogones in all lichens, and from every part of the world yet visited by man.

9. Many lichens possess, in addition to apothecia and spermogones, minute organs, outwardly resembling spermogones, called

Pycnides. They may be described in general terms as papillæform or wart-like bodies, generally black,—sometimes brown,—usually very minute,—generally partially immersed in the thallus, on the surface of which they are scattered,—occupying a site similar to that of the spermogones. Indeed they differ essentially from spermogones only in containing corpuscles, called *Stylospores,* which are spore-like bodies,—sometimes septate,—usually oval or pyriform in shape,—but varying greatly both in form and size, with oily, distinct contents, always borne on the apices only of simple or unicellular, strongish sterigmata.

10. As the essential difference between spermogones and pycnides lies in the characters of the contained corpuscles, and as their characters are of great importance, as bearing on the physiological functions of the said corpuscles, the comparison or contrast undernoted is made:—

Spermatia. [representing Spermogones.]	*Stylospores.* [representing Pycnides.]
1. Structure solid, homogeneous.	1. Hollow: contents heterogeneous—in part, at least, oily.
2. Always colourless.	2. Sometimes pale yellow.
3. Of extreme tenuity: generally linear—of equal thickness throughout—straight or curved—never spherical.	3. Vesicular: usually oval or pyriform.
4. Of uniform size and shape.	4. Varying more or less in size and shape.
5. Exist in myriads.	5. Greatly less abundant.
6. Absence of germinative power.	6. Presence of germinative power.
7. No oil globules intermixed: embedded in a mucilage.	7. Oil globules generally intermixed.
8. Borne on the apices and sides of the sterigmata—on the apices when they are simple, on the apices and sides when articulated.	8. Borne on the apices only of sterigmata, which are always simple and stoutish.

11. There is much more dubiety and difficulty regarding the nature of the pycnides and the functions of the stylospores than regarding the nature and functions of the spermogones and spermatia. Two hypotheses have been advanced regarding the pycnides and stylospores, viz.—

a. That they are substitutes for the spermogones and spermatia,—or in other words, a different form or type thereof. What lends probability to this view, is the perfect resemblance to spermogones in outward appearance, site, &c. of such pycnides as those of *Peltigera*, in which the contained corpuscles are the only reason for regarding the conceptacles as pycnides rather than spermogones. But in certian lichens pycnides co-exist with spermogones of the ordinary character.

b. That they are sporoid in function as well as form and general aspect. The strong argument in favour of this view is their germinative faculty. According to this view, pycnides may be regarded as secondary apothecia, or female organs,—and stylospores as secondary or supplementary spores. It has been noticed that, in certain cases, there is a general resemblance in form between the stylospores and the spores of the same species; but this, if not exceptional, is still far from being the general rule.

12. Pycnides are much more common among the lower, or crustaceous, lichens, than among the higher or fruticulose, filamentous, and foliaceous ones; while, on the other hand, the spermogones are most abundant and distinct in the latter. Pycnides would appear to be a connecting link between the lichens and the fungi, and we find them most frequent, perhaps, in species most nearly allied to the fungi.

13. Pycnides may occur in plants or specimens bearing apothecia, but not spermogones; or they may occur alone, both apothecia and spermogones being absent; or pycnides and spermogones, one or both, may occur in species seldom or never bearing apothecia, as in some species of *Strigula*.

14. Pycnides, from their outward resemblances, are apt to be confounded with, or mistaken for,—

a. Spermogones.

b. Minute *Verrucarias*.

c. Minute parasitic fungi, for which, indeed, they have hitherto been almost universally mistaken. Pycnides resemble the fructifications of fungi, called by the older mycologists, *Diplodia*, *Phoma*, *Septoria*, *Cytispora*, *Sclerotium*, *Mesalmia*, *Phyllosticta*, and *Polystigma*.

15. A few lichens,—especially crustaceous ones,—possess several forms of spermogones, or of pycnides, or of both,—though such a phenomenon is comparatively rare. This is just what occurs in such fungi as *Erysiphe*, which has *five* several forms of reproductive

organs. The simultaneous occurrence of spermogones and pycnides also characterises certain fungi, *e.g.*, *Sphæria epicymatia*, Wallr. Indeed, the presence of multiform reproductive organs in lichens, renders more indefinite and unsatisfactory the line of definition between them and the fungi; or in other words, renders more clear and intimate the alliance between these two great cryptogamic families.

16. By the discovery in Germany in 1850, and the subsequent description by various French and German authors, of the spermogones and pycnides of lichens, this family of plants has been placed on, at least, as good a footing, in respect of their anatomy and physiology, as other cryptogamic families, which have hitherto been more carefully and successfully studied.

The following Donations to the Library were announced:—

Anniversary Address to the Geological Society of London. By Major-General Portlock, R.E. 8vo.—*From the Author.*

The Quarterly Journal of the Geological Society. February 1859. 8vo.—*From the Society.*

The American Journal of Science and Arts. January 1859. 8vo. *From the Editors.*

Proceedings of the Royal Geographical Society of London. Vol. III. No. I. 8vo.—*From the Society.*

Journal of Agriculture, and Transactions of the Highland and Agricultural Society of Scotland. No. 64 (March 1859). 8vo. —*From the Society.*

Quarterly Journal of the Chemical Society. January 1859. 8vo. —*From the Society.*

Journal of the Statistical Society of London. Vol. XXII. Part. 1. 8vo.—*From the Society.*

A Catalogue of the Graduates in the Faculties of Arts, Divinity, and Law, of the University of Edinburgh since its Foundation. 8vo.—*From the University.*

Comets: their Constitution and Phases. By Christopher Kemplay. 8vo.—*From the Leeds Philosophical and Literary Society.*

Report on the Teneriffe Astronomical Experiment of 1856. Addressed to the Lords Commissioners of the Admiralty. By Professor C. P. Smyth. 4to. *From the Author.*

Report of the Proceedings of the Geological and Polytechnic Society of the West Riding of Yorkshire. 1857–8. 8vo.—*From the Society.*

China and its Trade. By John Crawfurd, F.R.S. 8vo.—*From the Philosophical and Literary Society of Leeds.*

Sensorial Vision. By Sir J. F. W. Herschel, Bart. 8vo.—*From the same.*

Annual Report of the Leeds Philosophical and Literary Society for 1857–8. 8vo.—*From the Society.*

On the Structure of Lecidia lugubris. By W. Lauder Lindsay, M.D. 8vo.—*From the Author.*

Atti dell' imp. Reg. Istituto Veneto de Scienze, Lettere ed Arti. Dal Novembre 1858 all' Ottobre 1859. Tomo IV. Dispensa Terza. 8vo.—*From the Institute.*

Transactions of the Botanical Society of Edinburgh. Vol. I. Part 3. Vols. II., III., IV., and V. Proceedings for 1856. Sixth, Seventh, and Eighth Annual Reports and Proceedings for 1841–44. 8vo.—*From the Society.*

Donation to the Museum—

Geological Specimens from the Peak of Teneriffe.—*By Professor C. Piazzi Smyth.*

Monday, 21*st March* 1859.

PROFESSOR KELLAND, Vice-President, in the Chair.

The following Communications were read:—

1. On some First Principles of a Mental Science, deduced from Correlations of the Primary Laws of Matter and Mind. By Dr Laycock.

The author commences his communication by showing the need that has arisen for a scientific exposition of the laws of thought in relation to the laws of life and organization. In all the practical business of society, as well as of the physician, the phenomena of life and mind are inseparably associated; and consequently without such scientific exposition anything like a scientific application of mental philosophy to medicine and the sciences of human nature, included under sociology, is impossible. But physiology is itself a derivative science, inasmuch as vital processes are primarily dependent upon certain molecular forces of matter, known as light, heat, chemical affinity, &c. Consequently, if philosophy cannot be separated from physiology or the science of vital function, neither can physiology be separated from physics. Philosophy, therefore, ought to include in one harmonious and comprehensive body of doctrine all the fundamental principles of the natural sciences. It would to this end take cognisance of three great departments of human knowledge—the physical, the vital or biological, and the metaphysical.

The author next shows that as science has already developed in each of these departments a number of general laws which only await higher generalizations to bring them all under laws still more general, and thus secure that unity of the sciences to which they all tend, it is the proper business of philosophy to supply those higher generalizations. These, the author argues, must be derived from the common sense and experience of mankind; for that experience consists in a knowledge of the laws of nature,—not formularized, it is allowed, in express propositions,—but acted upon by man in all his relations. The experience of mankind is *expressed*, however, in at least three different, yet closely related modes—namely, in his language, in the laws which regulate his conduct as a social being, and in his conduct as an individual. If man's experience of the great uniformities of nature, as expressed in these three modes, can be compared with the results of scientific research and formularized into general propositions, these propositions will express fundamental empirical laws fit to be received amongst the highest generalizations of philosophy, considered as a practical knowledge of the general laws of nature. After having shown by illustrations the application of this method of deducing general empirical laws, the author proceeds to examine the generalizations or fundamental ideas implied in the words *law*, *force*, *mind*.

The term *law*, as commonly used, denotes the written or spoken words in or by which is expressed the will of any person or persons, having the power to compel others to adapt their conduct to the will so expressed. Conduct so compelled would be a uniform succession of events occurring according to law. In science, whenever a uniform succession of events or of phenomena in nature is observed to take place, the expression in words or signs of that uniformity is termed a law. Thus it is a law of nature that air has weight, that all men die, and the like. But, as the order of succession is logically a fixed and necessary order, so the law which represents or expresses the order is logically a necessary law. In this attribute of fixedness the mind recognises a resemblance between the order and the law which expresses it, so that as to the quality of necessity and fixedness, the law and the order are convertible things, and the law stands for the order.

Force is a word arising out of man's experience of this necessary order of events. He finds the fixed order to be an inevitable order, and this idea of inevitableness implies logically an irresistible force or power which compels to or maintains the order. Hence, correlative with order and law there is a conception of the power or force upon which the inevitableness of the order depends. In this way law and force become in language convertible terms; and we speak equally of the law of gravity and the force of gravity,—the laws of attraction and the force of attraction; and we say generally of a thing, that it has the force of law. Nevertheless, the term force has its own meaning, and specially includes or expresses the idea of causation independently of inevitableness. In its strictest sense it is that which compels to the course of events expressed in the law without reference to the formula or the order. Yet the term is used correlatively with the order expressed; so that order, law, and force equally express the same ideas of uniform sequence, fixedness, inevitableness, and an inevitably compelling force. Thus motion in a straight line implies both a force that impels, and an unchanging continuousness in the line of motion until an equal force interrupts or deflects. Starting from these generalizations of the words force and law, the author proceeds to shew, that as the primary laws and forces are thus inevitable and fixed, the order which they compel and express can only be modified by equal forces acting according to like laws; since, logically, the inevitable alone can control itself. Hence, he concludes, that all these phenomena of nature which appear to be deviations from the primary forces and laws of nature (as the resistance to the force of gravity which the upright position of man implies, and the like) are in fact due to laws and forces derivative from the primary, and which are therefore secondary and contingent laws and forces. And since the phenomena of nature are all, in fact, deviations from one or two primary laws or forces, science may be defined to be a knowledge of these deviations from the primary laws and forces, formularized in contingent or derivative laws. Hence, too, the tendency of all the sciences to centre upon a few generalizations. It is, in fact, upon these ideas that the recent doctrines as to the correlations or the physical forces are substantially founded.

The author having called attention to these doctrines, shows that the generalizations he points out extend to sociology. Social laws must, as to society, be logically necessary laws, for without them society cannot exist. If the laws be not executed, society, as held together by law, ceases to exist, and is resolved into its elements. Hence all the laws of society whatever, whether written or implied, are necessarily correlative with a power or force sufficient to compel men to adopt their actions to the prescribed order. In this way we speak of the *force* of opinion in reference to the unwritten natural laws, and of the *requirements* of the law, just as we speak of the necessary laws of nature and the inevitable laws of God.

In determining the generalizations included in the word *mind*, the author observes that, when we speak of the law, or laws, in reference to the conduct of man in society, we not only have in view the fact that there is an order of events or actions to be followed, expressed in law, and a power to compel to that order, or obedience to the law; but we know as a fact of experience that the order is designed with regard to certain ends to be obtained, as *results* of the order. And we can go a step farther, and find that the designer (or designers) either is the force necessary to compel obedience to the designed order, or delegates it to others. In the great uniformities of nature we recognise a similar cause. When we speak of the necessary laws of those uniformities, we not only include a conception of the force which compels the uniformities, but we go beyond it in causation, and think of the something which both designed the order implied in the uniformities, and originated the compelling force. Now this is what men designate mind. It is the first cause in creation, as it is in man's actions. It follows, therefore, that a true mental science should set forth the correlations between mind as manifested in man, and mind as manifested in creation. In addressing himself to this task, the author points out, by way of preliminary remark, that the design must be carefully distinguished from the designer; and the law of design or the expression of the results of the order, from the thought or the thinker. If we examine the order of phenomena in creation, we can at least conceive (what is analogous to our own experience of our own mental processes and acts), that the whole order of creation was pre-existent in the Divine mind as a thought before the order itself began. But farther, we can also see the logical necessity, that when once the design was made it must be inevitable, for we find that the great laws of nature in which design is expressed are inevitable. Hence a mental law and a mental force both dominate, and are correlative with the physical laws and forces, or the forces of matter. So that there is no such thing in nature as chance; the word only implying the unknown to man as to order, law, and cause, and more especially applicable to derivative laws and forces. It follows, therefore, that what we term physical laws and forces are only lower generalizations of a primary mental law and force, and consequently correlative therewith. Motion and order are thought in act. So that the entire phenomena of creation are under the derivative laws and forces of mind.

Such a generalization implies, however, a change in the method of research. Experience is content to know what is the uniform succession or order of phenomena, and what are the laws and forces correlative therewith; but so soon as a law of design is the object of inquiry, it becomes necessary to examine the order of phenomena with regard to the ends arrived at in the order; that is, to determine the *results* of the uniform succession. Hence *teleology*, or the doctrine of final causes, is as applicable to both physical and biological researches as to the metaphysical, and must be considered the true guide to the highest researches in natural science, just as the law of design and mind subsume all other forces and laws.

Proceeding to apply the teleological method, the author next inquires what is the most general physical result in creation, or "Final cause" of the primary law of design and its correlative force. This result, he argues, must logically be at least the combination of things into wholes, or a whole, of mutually related parts; and such is practically the result in the physical as distinguished from the moral world, of both the general and the derivative laws and forces. The primary forces of matter operate to the *end* that the great masses of matter shall form wholes of mutually related parts, as in our planetary and other solar systems, and in the universe made up of systems; while the derivative laws and forces operating in life and organization, *result* in an *organism*, which, according to the definition of Kant, " is that in which all the parts are mutually ends and means."

Applying these doctrines to the primary law of consciousness, the author maintains that such a result of the law of design, aimed at and attained, may be designated in relation to the consciousness, the *idea* of unity; in relation to the external world, the *law* of unity. The law implies two things—construction of parts in mutual relation—or *organization;* and action of the parts in mutual relation as a whole, or *individual life*. The fundamental idea of consciousness—the intuition in man of the " I am," or Ego, is the ultimate result presented to the consciousness of these two things. It is the final cause of all those derivative or correlative laws and forces of the primary law of mind and primary forces of matter, which, operating in his body as " teleorganic " laws and forces, or vital laws and forces of adaptation to ends, build up his body into an organism.

In this way (the author proceeds to show) we arrive at the origin of all other necessary or intuitional truths, of which the conception of design itself is one of the most fundamental. The mind of man having thus the results of the great law of design presented to it as intuitive ideas, in virtue of the teleological operation in his organization of the physical and vital forces, must be potentially, and when fully evolved in correlation with organization, actually a microcosm. And it follows, from the correlation of the physical, vital, and mental forces of creation, that all the intuitive ideas of the human mind are to be discovered in the external world, as derivative results of the primary law of design; or, in other words, as ideas of the Great Thought manifested in creation. The author therefore maintains that such a true science of *ideology* or metaphysics as could be built upon these principles, would be fit to take its place at the head of all the natural sciences; for we can thereby attain to a criterion of absolute truth, and correct the dimly felt intuitions of our own consciousness, by comparing them with the fixed, immutable, and eternal conceptions of the Divine mind, as manifested in creation.

The author next proceeds to illustrate these views by special examples. Thus, in *psychology*, he shows that the will is an intuitive exercise of power according to the law of design. That pleasure is felt, and the condition is good, when the operations of the forces by which the organism is built up as a whole are in accordance with the ends arrived at, and with the order fixed for those ends; that, on the contrary, pain is felt, and the condition is evil when disorder arises, and the results are in disaccordance with the ends aimed at. It is necessary to bear in mind that the ideas included in general terms correlate each other in psychology as well as in physics. Thus Order, regard being had to its results, is logically correlative with Good; for good in creation is the result of order, and of order alone. Order, again, is as general a law as design; consequently the deviations from the primary law of design, known as evils, are correlative with, and derivative from the primary law of order, just as the physical and vital forces are derivative from the primary forces. Again, perfection correlates the law of order and the law of unity; for, admitting that there are degrees of perfection, the highest perfection is attained when, with the greatest multiplicity or differentiation of parts, there is the most complete unity, or adaptation of those parts to each other as ends and means. This is the perfection of society as well as of organisms.

In *biology*, the author shows that the laws of unity of type and permanence of species are compatible with an empirical law of life—the law of incessant change. The adaptation of an organism to the external world is instinct; but since the operations of the forces of the external world which maintain life, as heat, light, and the like, are constantly varying, so, according to the teleological law, must the phenomena of life and instinct be constantly varying. Hence, correlative with the fixed and immutable law of design, as manifested in unity of type, and derivative therefrom, is the law of incessant change; and this is a primary law of creation as well as of life. For, just as the motion of a planetary body round a centre or centres is due to incessant variations (as marked by every point in the described curve), caused in the line of direction by a deflecting force, so all the variations in organisms, whether animal or vegetable, from the first, or correlative law of design, as manifested in unity of type, are results of deflecting forces, *i.e.*, of external conditions, influencing organisms to change from the type in time and space. In this way, unity of type and permanence of species are correlative with incessant variations in the transmissions of the characters and instincts of the species, whether they be simply morbid, and known as hereditariness, or appear to give rise to new species.

The author finally shows, that as unity of structure implies unity of function, we have in these principles the foundation for an investigation of what has hitherto been considered wholly inscrutable, namely, the relations of the organization to the consciousness; or, in other words, the connection of body and mind. Mind is not merely inseparably associated with the primary forces of matter; it acts in and by them. Their phenomena are its signs. Hence, since the order of these phenomena and the action of the forces can be expressed numerically, it follows that the results or ends arrived at can be expressed numerically; or, in other words, the teleological laws can be reduced to numerical formula. This can be done already as to nutrition and development, and the *forms* of vegetables and animals; but since all the successional states of our consciousness correspond to successional vital states, occurring according to the teleological law of the physical and vital forces, it is clear that the signs which express the law of succession of the one series, might be made to correspond to the laws of succession of the other. In this way, the brain may be looked upon as the instrument whereby the mind is brought into immediate relation,—not with matter alone,—but with the forces of matter; and our intuitive cognitions may be considered as direct and immediate cognitions of the teleological operations of those forces in our organization.

2. Verbal Notice respecting the Remains of a Seal found at Portobello. By Dr Allman.

Professor Allman called attention to some bones discovered by Dr Andrew Balfour in a clay field near Portobello, and forwarded by him for presentation to the Museum of Natural History. They prove to be bones of a seal, and consist of some vertebræ, a portion of a scapula, a radius, a femur, and a fibula. They thus afford an additional instance to the few already recorded, of the occurrence of phocine remains in the British Islands. The deposit in which they occurred appears to belong to the period of the boulder clay. They were found about 20 feet above the present level of highwater, and about 15 feet below the surface of the soil.

3. On the Composition of Old Scotch Glass. By Mr Thomas Bloxam, Assistant Chemist to the Industrial Museum. Communicated, with a Preliminary Note, by Professor George Wilson.

We have recently been engaged in the laboratory of the Industrial Museum in executing some analyses of glass, which, as of general interest, I lay before the Society. The analyses in question have been made by Mr Bloxam, the official laboratory-assistant, and it is desirable first to mention with what object they were undertaken. I have limited the investigation in the first place to common bottle glass and window glass in use in Scotland, and so far as could be ascertained, also manufactured in Scotland. As yet we have only overtaken six varieties, and the full import of their analyses will not appear till additional examples have been examined. The following statement aims at nothing more than the establishment of certain data in the glass-manufacture :—

In the case of window-glass, I was anxious to obtain a specimen manufactured before the introduction of the process now so largely followed for the conversion of common salt into soda-ash, the form of alkali now used by the maker of window-glass. Through the assistance of my friend, Mr James Young, I obtained such a specimen. It constituted part of a window-pane, known to have been procured from the Dumbartonshire Glass-Works, and originally employed in glazing a house in Russell Street, Glasgow, built some forty years ago.

Mr John Young, who died last December, aged eighty-five, remembered the building of the house, and knew the source of the glass. He superintended the cutting out of the glass, which was taken from an upper pane, as less likely than a lower one to have been introduced to replace a broken sheet of earlier date. He could also testify that the putty was that originally employed in fixing the pane.

From the analysis it will be seen, that unlike our later window-glass, it contains potash as well as soda. In all probability the alkali used in its manufacture was kelp, which contains both alkalies, and was the chief source of soda to the Scotch glass-maker and soap-maker, till the salt process was established. The glass is inferior in the important quality of colourlessness to the window-glass now manufactured, a defect not explicable by a reference to the presence of potash, which has a less colouring influence on glass than soda. The green tint so manifest is sufficiently explained, however by the large amount of oxide of iron discovered on analysis. Of dark bottle-glass, specimens abundantly authentic were obtained from the relics of Dr Joseph Black's apparatus. They were probably made at Leith, where ordinary bottles have been manufactured for a long period from clay, sand, salt, and other cheap materials of the neighbourhood. Newcastle, however, has long directed much of the bottle-making to herself, and still more recently Belgium is injuring the trade at Newcastle. In contrast with this I have obtained examples of Chance's glass, made by simply melting ragstone or basalt, the revival of an old French mode of glass-making, extended by the English manufacturer to the production of glass tiles, vases, and large slabs. Could our native trap-rocks be at once melted into available glass, it would be an important addition to the industrial manufactures of the country; but the relinquishment at Birmingham of the basalt process, as unremunerative and impracticable, is not encouraging.

The window-glass from Dunfermline Abbey was given by Dr John A. Smith, a zealous member of the Society of Antiquaries. Dr Smith writes in reference to it—" It was picked up by Bailie Mitchell of Dunfermline, in November 1818, when various diggings were made above the ruins of the old Abbey, preparatory to the rebuilding of the church, and it was said to have been found closely adjoining the site of the great east window of the Abbey.

" Bailie Mitchell gave it to an antiquarian acquaintance of mine, from whom I received it."

The exact age of the glass is thus unknown, and the place of its manufacture quite uncertain. It is, however, certainly old and historically interesting.

Regarding the Abbey, Mr John Stuart, Secretary of the Society of Antiquaries, furnishes the following information :—

" Queen Margaret founded a church at Dunfermline immediately after her marriage in 1070. It was probably of temporary description; and a church completed by David I. was dedicated in 1150."

At the translation of Queen Margaret's relics in 1250, a new church is spoken of, which seems to have consisted in an enlargement of the choir of the previous church, so that the date of foundation and addition would be 1150 and 1250."

The glass from Dunfermline Cathedral was given me by the sexton, as having fallen from the windows, and had been long in his possession.—G. W.

The specimens of glass submitted to investigation were six in number, namely, four window-glasses, one bottle-glass, and one basalt-glass.

1. Window-glass from Dumbartonshire.
2. Fragments from a window in Dunfermline Abbey.
3 and 4. Fragments of window-glass from Dunblane Cathedral.
5. A bottle from the laboratory of Dr Joseph Black.
6. Basalt-glass, manufactured by the Messrs Chance and Co.

Where the quantity of material was sufficient, the following points were determined with each specimen.

1° Specific gravity.
2° Solubility in water.
3° Solubility in alkalies.
4° Solubility in acids.
5° Quantitative composition.

The method of examination was that employed by most chemists for the analysis of silicates, namely, fusing the substance with carbonate of potash and soda, dissolving the fused mass in acid, and estimating the substances in solution. The solvent action of water, acids, and alkalies was ascertained by subjecting the specimen, in fine powder, to each of these menstrua, for some days, and in most cases analysing the liquid containing the soluble part of the glass, The specific gravity was determined in the usual manner practised in the laboratory, a mean number being deduced from the results of three experiments.

Dumbartonshire window glass had a specific gravity of 2·55.

Water dissolved substances from it to the amount of ·14 of a grain per cent., consisting mainly of silica, together with lime, iron, alumina, magnesia, and soda in smaller quantities.

Potash dissolved the glass to the extent of ·76 of a grain per cent.

The quantitative composition of Dumbartonshire glass is the following:—

Silica, . . .	65·51
Protoxide of Iron, .	3·68
Alumina, . .	3·67
Soda, . . .	10·75
Potash, . .	5·55
Lime, . .	10·42
	99·58

Ratio of oxygen in the bases to that in the silica as 3 to 11.

The specimen of Dumfermline Abbey glass was too small to allow of any characters beyond the specific gravity and chemical composition being ascertained. The specific gravity was found to be 2·63; chemical composition to be,—

Silica, . . .	44·47
Protoxide of Iron, .	4·98
Alumina, . .	12·21
Lime, . . .	17·23
Magnesia, . .	3·81
Soda, . . .	13·90
Potash, . .	3·20
	99·80

Ratio of the oxygen in the bases to that of the silicic acid as 3 to 4.

The third and fourth specimens examined were from Dunblane cathedral windows.

They were of a blue colour, the first being the darker in tint, and were too small to admit of complete examination.

The first sample had a specific gravity of 2·63, and consisted of,

Silica, . . .	62·70
Protoxide of Iron, .	1·26
Alumina, . .	2·60
Lime, . . .	6·25
Oxide Copper, .	4·99
Potash, . .	·80
Soda, . . .	21·40
	100·00

Ratio of oxygen in bases to that of the silicic acid as 3 to 10.

The second specimen had a specific gravity of 2·47 and chemical composition as follows:—

Silica, . . .	49·66
Protoxide Iron, .	6·60
Alumina, . .	11·52
Lime, . . .	19·25
Oxide of Copper, .	1·32
Potash, . .	1·53
Soda, . . .	10·09
	99·97

Ratio of oxygen in bases to that of silicic acid as 3 to 5.

The next specimens submitted to investigation, was a bottle used by Professor Black for chemical purposes.

The specific gravity was 2·75.

Water was found to dissolve from it ·22 of a grain per cent., consisting of lime, oxide of iron, silica, and magnesia.

Hydrochloric acid dissolved substances to the amount 2·82 per cent., and potash, ·56 of a grain per cent.

The glass had the following composition:—

Silica, . . .	56·90	Ratio of oxygen in bases to that of silicic acid as 1 to 2.
Protoxide of Iron, .	3·61	
Alumina, . .	10·22	
Lime, . . .	25·80	
Potash, . .	1·90	
Soda, . . .	1·55	
	99·98	

The last sample made the subject of analysis was the so called basalt glass of Messrs Chance and Co.

It is produced by the mere fusion of basalt, is very hard, and of a black colour.

The specific gravity was ascertained to be 2·709.

Water dissolved ·34 of a grain per cent., consisting of silica, protoxide iron, lime, and magnesia.

Hydrochloric acid dissolved 3·4 per cent., and potash 1·44 per cent.

The composition of the basalt glass may be thus represented:—

Silica, . . .	54·88	Ratio of oxygen in bases to that of silicic acid as 1 to 2.
Protoxide Iron, .	17·83	
Alumina, . .	11·54	
Lime, . . .	9·26	
Potash, . .	1·05	
Soda, . . .	5·34	
	99·90	

Action of Solvents upon the foregoing varieties of Glass.

		Action of Water.	Action of Hydrochloric Acid.	Action of Potash.
I.	Dumbartonshire glass, . . .	Dissolved ·14 of a grain per cent.	Dissolved ·72 of a grain per cent.	Dissolved ·76 of a grain per cent.
II.	Dunfermline Abbey glass, . .	Too small for experiment.	... ...	... ...
III. IV.	Dunblane glasses, ...	Do. Do.	... ...	... ...
V.	Black's glass, ...	Dissolved ·22 of a grain per cent.	Dissolved 2·82 grains per cent.	Dissolved ·56 of a grain per cent.
VI.	Basalt glass, ...	Dissolved ·34 of a grain per cent.	Dissolved 3·4 grains per cent.	Dissolved 1·44 of a grain per cent.

Chemical Composition.

	I.	II.	III.	IV.	V.	VI.	Specific gravity.
Silica, ...	65·51	44·47	62·70	49·66	56·90	54·88	I. 2· 55
Protoxide Iron, ...	3·68	4·98	1·26	6·60	3·61	17·83	II. 2· 63
Alumina, ...	3·67	12·21	2·60	11.52	10·22	11·54	III. 2· 63
Lime, ...	10·42	17·23	6·25	19·25	25·80	9·26	IV. 2· 74
Magnesia.	...	3·81	...	...	...	...	V. 2· 75
Oxide Cobalt, ...	...	...	4·99	1·32	...	...	VI. 2·709
Potash, ...	5·55	3·20	·80	1·53	1·90	1·05	..
Soda, ...	10·75	13·90	21·40	10·09	1·55	5·34	...
	99·58	99·80	100·00	99·97	99·98	99·90	
Ratio of Oxygen in bases to that of Silica,	3:11	3:4	3:10	3:5	1:2	1:2	

The following Gentleman was elected an Ordinary Fellow:—

Lieutenant John Hills, Bombay Engineers.

The following donations to the Library were announced:—

Note sur la Comète de Donati, par M. E. Plantamour. 8vo.—*From the Author.*

Résumé Météorologique de l'années 1855, 1856, et 1857, pour Genève et le Grand Saint-Bernard, par M. E. Plantamour. 8vo.—*From the Author.*

Observations Astronomiques faites a l'Observatoire de Genève, dans les années 1851 et 1852, par M. E. Plantamour. 4to.—*From the Author.*

De la Température a Genève d'apres vingt années d'Observations 1836 á 1855, par M. E. Plantamour. 4to.—*From the Author.*

Sketch of the Civil Engineering of North America, by David Stevenson, F.R.S.E. 8vo.—*From the Author.*

Mémoires de la Société Impériale des Sciences Naturelles de Cherbourrg. Tome V. 1857. 8vo.—*From the Society.*

Transactions of the Royal Society of Literature. Vols. I., II., III., IV., V., and Part I., Vol. VI. 8vo.—*From the Society.*

Occasional Papers on the Theory of Glaciers, with a Prefatory note on the Recent Progress and present aspect of the Theory, by James D. Forbes, D.C.L., F.R.S., &c. 8vo.—*From the Author.*

Bulletin de la Société des Sciences Naturelles de Neuchatel. Tome IV., Cahier III. 8vo.—*From the Society.*

Bulletin de la Société de Geographie, Tome XVI. 8vo.—*From the Society.*

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Tome XIV., 2^{e} parti. 4to.—*From the Society.*

Untersuchungen über die Rechtung und Stärke dis Erdmagnetismus an verschiedenen puncten des Südwestlichen Europa. Von Dr J. Lamont. 4to.—*From the King of Bavaria.*

Abhandlungen der Kœniglich Bayerischen Akademie der Wissenschaften. Philos-philologischen Classe, Vol. VIII., Abth. 3. Math-physicalischen Classe, Vol. VIII., Abth 2. Historisschen Classe, Vol. VIII., Abth 2. 4to.—*From the Academy.*

Gelehrte Anzeigen. Vols. XLVI. and XLVII. 4to.—*From the same.*

Über die geschichtlichen Vorstufen du neuern Rechtsphilosophie. Von Prof. Dr Carl Prantl. 4to.—*From the same.*

Über Neuaufgefundene Dichtungen. Francesco Petrarca's. Von Prof. Dr G. M. Thomas. 4to.—*From the same.*

Über Johannes Muller und sein Verhaltnis zum jetzigen. Standtpunkt der Physiologie. Von Dr Th. L. W. Bischoff. 4to.—*From the same.*

Catalogus Codicum Manu Scriptorum Bibliothecæ Regiæ Monacensis. Tomus VII. 8vo.—*From the same.*

Lighthouse Illumination: being a Description of the Holophotal system, and of Azimuthal-condensing, and Apparent Lights, with other Improvements. By Thomas Stevenson, F.R.S.E. 8vo.—*From the Author.*

Monday, 4th April 1859.

PROFESSOR CHRISTISON, Vice-President in the Chair.

The following Communications were read:—

1. On the Gradual production of Luminous Impressions on the Eye. Part II. By Professor Swan.

The author, in a paper communicated to the Royal Society of Edinburgh in 1849,* described a method of observation by which he had succeeded in measuring the brightness of visual impressions of short duration. This consisted in causing a disc, with a sector of a known angle cut in it, to revolve with a known uniform velocity between the eye and a luminous object. At each revolution of the disc a flash is seen. The time during which the light has acted on the eye is easily computed from the angle of the sector and velocity of the disc; and the brightness of the flash is ascertained by photometric arrangements. By this method the brightness of impressions formed on the eye by light acting for short intervals of time varying from ·1 to ·001 of a second was ascertained with results which have been described in the paper already referred to.

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* Edinburgh Transactions, vol. xvi, p. 581.

It seemed desirable to extend the observations to impressions formed on the eye in intervals of time still shorter than ·001 of a second; and it may seem that this could be accomplished, either by diminishing the angle of the sector, or by increasing the diameter or velocity of rotation of the disc. There are obviously, however, limits to the narrowness of the sector, and to the diameter of such discs as can be used conveniently; and the velocity with which the disc may be driven is also limited, for when the number of revolutions exceeds about ten in a second, the successive impressions, which it is proposed to observe separately, become blended into a single nearly uniform impression, owing to their persistence on the retina. The instrument now described to the Society is devised for the purpose of separating a *single* impression out of the multitude of impressions made by a rapidly revolving disc, so as to render it possible to observe the brightness of isolated visual impressions formed by light acting on the eye for extremely short intervals of time.

The instrument consists of a train of wheels and pinions by which a disc having a sector cut in it is driven with great velocity. The numbers of teeth in the wheels and pinions are so arranged that each wheel, as well as the disc, makes ten revolutions for one revolution of the wheel by which it is driven. Each of the two last wheels of the train, which are of solid metal, has a hole pierced in it, through which light transmitted by the sector can pass to the eye; and the wheels are so placed that at each hundredth revolution of the sector, and only then, the sector in the disc and the holes in the wheels come into the same straight line, so that the eye of the observer receives a single flash transmitted through the holes in the wheels. The result of this arrangement is, that although the disc be driven at the rate of a hundred revolutions per second, so that the impressions produced by the successive flashes transmitted by it when seen by the unassisted eye would be blended into an uniform impression, yet the observer, looking through the holes in the wheels, receives only a single flash of light once a second. The brightness of the observed isolated flashes may be ascertained by photometrical means, similar to those employed by the author for the same purpose in 1849, and which he has fully described.

An Instrument for producing Isolated Luminous Impressions of extremely short duration, varying from one-tenth to one millionth of a second, was shown.

2. On the Destructive Effects of the Waves of the Sea on the North-East Shores of Shetland. By Thomas Stevenson, C.E., F.R.S.E.

The author stated, that the present communication might be regarded as supplementary to the one describing the results of his marine dynamometer, which would be found in the 14th volume of the "Transactions." On the Bound Skerry of Whalsey, which is only exposed to the waves of the North Sea or German Ocean, he had found, on first landing in 1852, masses of rock, weighing $9\frac{1}{2}$ tons and under, heaped together by the action of the waves at the level of no less than 62 feet above the sea; and others, ranging from 6 to $13\frac{1}{2}$ tons, were found to have been quarried out of their positions *in situ*, at levels of from 70 to 74 feet above the sea. Another block of $7\frac{7}{10}$th tons, at the level of 20 feet above the sea, had been quarried out and transported to a distance of 73 feet from S.S.E. to N.N.W. over opposing abrupt faces as much as 7 feet in height. Somewhat similar evidences of the force of the sea were observed on the neighbouring islands, and more recently by Mr David Stevenson at Balta and Lambaness (in the most northern of the Shetland Islands), who, in a report made at the time, attributed the great force of the waves in the northern regions of the German Ocean to their exposure and the proximity of deep water to the land. In addition to these causes, the author referred to the strength of the tides, the configuration of the German Ocean, and to the great general depth of the water, as the probable causes why heavier waves are produced in the latitude of Shetland than are found, for example, on the coasts of England or Holland. The author, after alluding to the writings of Mr Airy and Mr Webster, referred, in particular, to this gradually decreasing general depth in passing from Shetland to Holland, as a main cause of the diminished magnitude of the undulations. That the waves are materially smaller in the southern than in the northern latitudes, may be inferred from the low, yet safe, level at which many of our southern sea-port towns have been built in reference to that of high water. The author considered that another proof that this reduction of the waves depended on the reduction in the depth of water, might be deduced from the structure of the bottom. He considered that the presence of *mud* at any depth might be taken as a certain proof that the agitation, originating at the surface, had ceased to be appreciable. If the geological formation did not produce a clayey deposit, or if strong submarine currents existed, the *absence* of mud might afford no proof of the magnitude of the waves ; but its *presence* in shoal water may be relied on as indicating with certainty that in whatever locality it is found there must be small disturbance at the surface, or, in other words, that there cannot be a heavy sea. Applying such a *test* to the present case—muddy deposits are found in from 80 to 90 fathoms off Whalsey, from which point southwards they are found in gradually lessening depths, till they rise to within 8 fathoms of the surface at the mouth of the Elbe. Similarly, at the Firth of Forth, the mud rises on the north side from 18 fathoms off Elie Ness to 7 at Burntisland; and on the south side, from 17 fathoms, near North Berwick, to 2 fathoms off Leith; while above Queensferry, even although the current is stronger in the higher portions of the estuary, the mud, owing to the comparative absence of waves, actually emerges above low water. It is well known, that on the banks of Newfoundland, and all round the British islands, where the bottom suddenly rises near the 100 fathoms line, the waves actually break. It seems reasonable, therefore, to infer, that the gradually decreasing depth of the German Ocean must as effectually, though not so suddenly, diminish the size of the undulations.

3. Notice of an Unusual Fall of Rain in the Lake District, in January 1859. By John Davy, M.D., F.R.SS. Lond. and Edin.

Whilst the average fall of rain during the preceding six years in January has been at Ambleside 4·22 inches; in this month, in the current year, the rain measured has amounted to 14·82 inches.

The quantity of rain that has fallen in other localities of the district during the same month is stated in a table, in which also is included the rain-fall in some other parts of the United Kingdom. In the former, it has ranged from 14·375 to 6·514 inches, diminishing with distance from the central mountains; in the latter, the range has been from 6·48 inches to 0·36 inch, diminishing, it would seem, with distance from the western coasts.

In another table some other instances of extraordinary rain-falls are given which occurred in the Lake District at Coniston and Ambleside, varying from 12 to 24·39 inches in a month.

A third table is appended, showing the quantity of rain monthly that has fallen at Seathwaite in Borrowdale during fourteen years; from which it appears that the maximum fall monthly has been 32·83 inches, and yearly 160·55 inches.

In connection with the rain-fall, other meteorological observations are offered, illustrative of the peculiarities of the last year and of the present season; of which, as regards the last, the most remarkable are, a prevalency of westerly winds, exceeding mildness, and a precocious spring; vegetation in the first week in March being at least a month in advance.

The following Donations to the Library were announced:—

Eroffnungorede der 43 sten Versammlung, Schweizerischen Naturforscher in Bern durch den Presidenten. Prof. Dr B. Studer. 1858. 8vo.—*From the Author.*

Atti del' imp. Reg. Instituto Veneto di Scienze, Lettere ed Arti. Dal Novembre 1858 all' Ottobre 1859. Tomo IV. Dispensa 4to. 8vo.—*From the Institute.*

Die Fortschritte der Physik im Jahre 1856. Dargestellt von der Physikalischen Gesellschaft zu Berlin. XII. Jahrgang. 1 Abth. 8vo.—*From the Society.*

Proceedings of the Academy of Natural Sciences of Philadelphia. 1858. Nos. 10–20. 8vo.—*From the Academy.*

The Mosiac Account of the Creation. By James C. Fisher, M.D. 8vo.—*From the Author.*

Review of Marcou's "Geology of North America." By James D. Dana. 8vo.—*From the Author.*

On Marcou's "Geology of North America." By Prof. Agassiz. 8vo.—*From Prof. Dana.*

Notes on the Currents of the Ocean. By James D. Dana. 8vo.—*From the Author.*

Observations on the Genus Unio. By Isaac Lea, LL.D., Vol. VI. Part II. 4to.—*From the Author.*

Papers from the Proceedings of the Academy of Natural Sciences of Philadelphia. By Isaac Lea. 8vo.—*From the Author.*

Account of the Remains of a Fossil Extinct Reptile recently discovered at Haddonfield, New Jersey. 8vo.—*From Dr I. Lea.*

Proceedings of the Royal Medical and Chirurgical Society of London, Vol. III., Part I. 8vo.—*From the Society.*

Journal of the Asiatic Society of Bengal. No. 269. 8vo.—*From the Society.*

Monday, 18*th April* 1859.

PROFESSOR CHRISTISON, Vice-President, in the Chair.

The following Communications were read :—

1. Researches on Radiant Heat. Part II. By Balfour Stewart, Esq. Communicated by the Secretary.

The first part of this paper describes the following groups of experiments :—

I. On the effect which roughening the surface of a body produces upon its radiation.

II. On the nature of that heat which is radiated by rock-salt at at 212° F.

III. On the radiation of glass and mica at high temperatures.

The second or theoretical portion of the paper has reference to the law which connects the radiation of a particle with its temperature, and to Dulong and Petit's experiments on this subject. The instruments used, and method of using them, were almost the same as described in the first series of these researches.

With regard to the first group of experiments, it was ascertained that roughening surfaces of glass or rock-salt with emery paper until they are dim for light, neither alters the quantity nor the quality of the heat which they radiate; the surface, although dim for light, being yet specular for heat.

With regard to the second group of experiments, it was shown that heat from rock-salt at 212° F. penetrates a screen of glass or mica less easily than lamp-black heat at 212° F.

It also penetrates a screen of mica split by heat less easily than the latter description of heat; but the difference of behaviour of the two kinds of heat with regard to this substance is not so marked as in the case of ordinary mica.

So far as tested by mica, and mica split by heat, it was shown that,—

Lamp-black heat of 700° F. bears to
Lamp-black „ 212° F., the same relation as
Lamp-black „ 212° F. bears to
Rock-salt „ 212° F.

that is to say, rock-salt heat possesses greater average wave-length than lamp-black heat.

With regard to the third group of experiments, it was shown that glass or mica, by being heated, does not change in any measure its capacity for transmitting a given description of heat; for instance, cold glass transmits heat of 700° F. just as well as glass heated to 700° F. does. Proceeding, then, to the theoretical part of the paper, it was then shown that, owing to the following facts:—

1*st*, That the absorptive power of a thin plate of any substance equals its radiative power.

2*d*, That (by the third group of experiments) the absorptive power of cold glass for heat of 700° F., is the same as that of glass heated to 700° F.

3*d*, That cold glass has a greater transmissive, or less absorptive power for heat of 700° F., than for heat of 212° F.

we must conclude that "the radiation of a thin plate of glass, or other substance, at 700°, bears a less proportion to the total radiation of 700° F., than its radiation at 212° does to the total radiation of 212° F. It was also shown that this difference is more marked for a thin plate than for a thick one; and it was argued, that Dulong and Petit's law does not express the law of radiation of a material particle, but that this law, whatever it be, increases (for all bodies) less rapidly with the temperature than Dulong and Petit's law.

2. Some Observations on the Coagulation of the Blood. By John Davy, M.D., F.R.S. Lond. and Edin.

Dr Richardson, in a recent and elaborate work on the blood, an extension of a Prize Essay on the cause of the coagulation of this fluid, has endeavoured to prove that this phenomenon is of a chemical kind, depending on the escape of the volatile alkali.

The author of the paper of the above title describes three sets of experiments which he has instituted for the purpose of testing Dr Richardson's hypothesis. In all his trials on blood, he has used that of the common fowl, its properties being best adapted to the objects in view. The results obtained were briefly the following:—

1. Ammonia added to the blood in small quantities did not prevent its coagulation; in larger quantities it retarded coagulation, and rendered the blood viscid.

2. On exposing mixtures of blood and ammonia, and of water and ammonia, to the open air, the loss of weight sustained in two or three minutes—the time required for the coagulation of the blood—was hardily appreciable, using a very delicate balance.

3. The moist fibrin of the blood subjected to the action of ammonia was found to be rendered transparent and viscid; but to be very slightly soluble.

These results, and others, such as the coagulation of the blood in close vessels, and the volatile alkali not having hitherto been detected in healthy blood, have led the author to the conclusion that the phenomenon under consideration still remains an unsolved problem; and that on the ground of mere probabilities it is not easy to say which of the two chief hypotheses advanced concerning it—the chemical and the vital—is deserving of preference.

3. On the Recent Vindication of the Priority of Cavendish as the Discoverer of the Composition of Water. By Professor George Wilson.

The object of this communication was to direct attention to the recent recovery of two documents establishing the priority of Cavendish as the discoverer of the composition of water. Their importance was indicated by the late Mr Robert Brown, the botanist, and his literary executor, Mr J. J. Bennett of the British Museum, has brought them before the Royal Society of London. They are both, contrary to general expectation, published statements contained in well-known works. The first is a section of De Luc's "Ideés sur la Météorologie," entitled, "Anecdotes relatives à la découverte de l'Eau sous la forme d'Air," in which the following decisive declaration occurs :—

"Vers la fin de l' année 1782, J'allai à *Birmingham* ou le Dr Priestley s'étoit établi depuis quelques années. Il me communiqua alors, que M. Cavendish, d'apres une remarque de M. Warltire; qui avoit toujours trouvé de l'*eau* dans les vases où il avoit brûlé un mélange *d'air inflammable* et d'air atmospherique; s'étoit appliqué à découvrir la source de cette eau, et qu'il avoit trouvé, 'qu'un mélange *d'air inflammable* et *d'air dephlogistiqué* en proportion convenable, étant allumé par l'étincelle électrique, se convertissoit tout entier en *eau*.' Je fus frappé, en plus haut degré, de cette découverte." (*Idées*, &c., tome ii., 1787, pp. 206–7.)

The important testimony thus borne to Cavendish's experiment having had as its object the discovery of *the source* of the water which appeared when hydrogen and oxygen are burned together; as its phenomenal result that in certain proportions *a given weight of the gases* in question could be burned into *the same weight of water;* and as its logical induction that *the gases had been converted into the water*, constituted Cavendish *a* discoverer of the composition of water. And as this conclusion was drawn in 1782, whilst Watt, the earliest counter-claimant of the discovery, did not draw his similar conclusion till 1783, the priority unquestionably belonged to Cavendish, who was thus *the* discoverer of the compositeness of water.

Reference was then made to the effort of Mr Muirhead to undervalue De Luc's testimony, on the plea that in another part of the "Idées" its author declared himself to have been ignorant of Cavendish's conclusions till 1783, and not to have learned them till after he was familiar with those of Watt. It was contended, on the other hand, that De Luc's two statements were not contradictory, but perfectly reconcileable with each other,—the one referring to Cavendish's interpretation of his experiments on firing hydrogen and oxygen, which De Luc learned from Priestley in 1782; the other to

Cavendish's full theory of the formation of water, which was not made public till January 1784, and which it could be shown by the Watt Correspondence De Luc did not become acquainted with till March of that year.

Special attention was drawn to the fact, that the section of De Luc's "Idées" from which the quotation was taken went over the same ground as the Watt Correspondence. This section contained the matured and authoritative publication of those views on the relative merits of Watt and Cavendish which are referred to by De Luc in the hasty private letters printed in the "Correspondence" in question, written when he was imperfectly informed on the points he was discussing, and not intended for publication. The author dwelt upon the omission of Mr Muirhead, when editing the Watt Correspondence, to point out this important fact to his readers, and the misleading effect of this omission in representing De Luc as much more the advocate of Watt's claims than in reality he was. In many respects the "Idées" supplemented the Watt Correspondence so far as the views of De Luc were concerned, and the latter work could not be understood unless read in the light of the former.

The second of the recovered documents was an extract from a Report to the French Academy, on M. Seguin's experiments on the Combustion of Hydrogen and Oxygen, dated 28th August 1790, written by La Place, in name of a Commission consisting, besides the reporter, of Lavoisier, Brisson, and Meusnier, all of whom sign it. The passage of most importance, as showing that Lavoisier abandoned in favour of Cavendish the claim he at one time preferred to be the discoverer of the composition of water, is as follows:—

"M. Macquer a observé dans son Dictionnaire de Chimie que la combustion des gaz hydrogène et oxygène produit une quantité d'eau sensible; mais il n'a pas connu toute l'importance de cette observation, qu'il se contenta de présenter, sans en tirer aucune conséquence. M. Cavendish parôit avoir remarqué le premier que l'eau produite dans cette combustion est le résultat de la combinaison des deux gaz, et qu'elle est d'un poids égal au leur. Plusieurs expériences faites en grand et d'une manière très-précise par MM. Lavoisier, La Place, Monge, Meusnier, et par M. Lefevre de Gineau, ont confirmé cette découverte importante, sur laquelle il re doit maintenant rester aucun doute." (*Annales de Chimie*, tome viii., pp. 258–9.)

In conclusion, the author dwelt upon the brightened moral aspect of the water controversy. From De Luc's "Idées" all trace of charge against the fair-dealing of Cavendish has vanished. Lavoisier is found making full, if somewhat tardy, amends for any wrong he did the English philosopher, and as De Luc and Lavoisier testify that Cavendish had reached his famous discovery in 1782, the most uncharitable must cease suspecting that he borrowed or stole it from Watt, who had it not to offer any one till 1783.

4. On the Preservation of Foot-prints on the Sea Shore. By Alexander Bryson, Esq.

The author remarked, that the impressions of the feet of birds and molluscs on wet sand, were liable to be effaced by the return of the tide; and that their preservation was owing to dry sand blown into the depressions from the shore, and again covered by a layer of moist sand or mud by the return of the tide. In regard to tracks left by gasteropodous molluscs, he stated that great caution was necessary to distinguish them from those left by Nereids; and instanced the case of a foot-track of a common whelk resembling the marks made by the Crossopodia on the Silurian slates. When the track of the whelk is filled up by the dry sand blown into the depression in the *line* of progress, no difficulty is felt in recognising it as the track of a gasteropod; but should the wind blow at right angles to the track of the mollusc, a series of setæ-like markings will be observed to leeward, caused by the dry sand adhering to the moist. In this instance, a geologist would naturally assign the markings to the impression of *Graptolites priodon*, or *sagittatus*; and if the wind suddenly shifted to the opposite direction, another series of setæ would be found on the other side of the mollusc's track, and the observer would at once pronounce the marks due to a gigantic Crossopodia, or fringe-footed Annelide.

The author also stated, that the so-called rain-marks found on sandstone and Silurian slates were formed by Crustacea, and that the cusps which geologists had supposed were the evidence of the force and direction of the wind during the shower, were produced by the wind blowing dry sand from the shore, and causing a raised barrier to leeward of the depression, where there was more moisture, and consequently more adhesion of the sand.

The following Donations to the Library were announced :—

Proceedings of the Natural History Society of Dublin for the Session 1857–58. Vol. I., Part 2. 8vo.—*From the Society.*

Einleitung in das Studium der Physik und Elemente der Mechanik von B. Studer, Professor, Bern. 8vo.—*From the Author.*

The Assurance Magazine and Journal of the Institute of Actuaries. No. 35. 8vo.—*From the Institute.*

Astronomical and Meteorological Observations, made at the Radcliffe Observatory, Oxford, in the year 1857. 8vo.—*From the Radcliffe Trustees.*

Journal of the Proceedings of the Linnean Society. Vol. III. No. 12. 8vo.—*From the Society.*

The American Journal of Science and Arts. Conducted by Professors Silliman and Dana. March 1859. 8vo.—*From the Editors.*

Englischer Liederschatz von Karl Elze. 32mo.—*From M. K. Elze.*

Westward, Ho! Britisch and Amerikanische Gedichte übersetzt von Karl Elze. 32mo.—*From the same.*

Shakespeare's Hamlet. Herausgegeben von Karl Elze. 8vo.—*From the same.*

Atlantis : Zeitschrift fur Leben und Literatur in England and Amerika. Herausgegeben von Karl Elze. Vols. I. and II. 8vo. —*From the same.*

Results of the Astronomical Observations made at the Royal Observatory, Greenwich, 1857. 4to.—*From the Royal Society, London.*

Jahrbuch du Kaiserlich-Koniglichen Geologischen—Riechenstalt. 1858. Nos. 1 and 2. 8vo.—*From the Society.*

Catalogues of Zoology. Published by the Trustees of the British Museum. 113 publications.—*From the Museum Trustees.*

PAGE
On the Spermogones and Pycnides of Lichens. By W. **Lauder Lindsay**, M.D., F.L.S. Communicated by Professor J. H. **Balfour**, ... 174
Donations to the Library, ... 182

Monday, 21*st March* 1859.

On some First Principles of a Mental Science, deduced from Correlations of the Primary Laws of Matter and Mind. By Dr **Laycock**, ... 183
Verbal Notice respecting the remains of a Seal found at Portobello. By Dr **Allman**, ... 190
On the Composition of Old Scotch Glass. By Mr **Thomas Bloxam**, Assistant Chemist to the Industrial Museum. Communicated, with a Preliminary Note, by Professor **George Wilson**, ... 191
Donations to the Library, ... 197

Monday, 4*th April* 1859.

On the Gradual production of Luminous Impressions on the Eye. Part II. By Professor **Swan**, . . . 198
On the Destructive Effects of the Waves of the Sea on the North-East Shores of Shetland. By **Thomas Stevenson**, C.E., F.R.S.E., ... 200
Notice of an Unusual Fall of Rain in the Lake District, in January 1859. By **John Davy**, M.D. F.R.SS. Lond. and Edin., ... 201
Donations to the Library, ... 202

Monday, 18*th April* 1859.

Researches on Radiant Heat. Part II. By **Balfour Stewart**, Esq. Communicated by the **Secretary**, 203
Some Observations on the Coagulation of the Blood. By **John Davy**, M.D., F.R.S. Lond. and Edin., . 205
On the Recent Vindication of the Priority of Cavendish as the Discoverer of the Composition of Water. By Professor **George Wilson**, ... 205
On the Preservation of Foot-prints on the Sea Shore. By **Alexander Bryson**, Esq., ... 208
Donations to the Library, ... 209

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

SESSION 1859–60.

CONTENTS.

Monday, 5*th December* 1859.

PAGE
Opening Address, Session 1859–60. By Lord NEAVES, . 212
Donations to the Library, ... 232

Monday, 19*th December* 1859.

Note on some Numerical Relations between the Specific Gravities of the Diamond, Graphite, and Charcoal Forms of Carbon and its Atomic Weight. By Dr LYON PLAYFAIR, C.B., F.R.S., . . . 241
Some Miscellaneous Observations on the Tadpole, and on the Albumen of the Newly-laid Egg. By JOHN DAVY, M.D., F.R.S. Lond. and Edin., . . 249
On Acupressure, a New Method of Arresting Hæmorrhage. By Professor SIMPSON, ... 249
Donations to the Library, ... 252

Tuesday, 3*d January* 1860.

Some Miscellaneous Observations on the Growth of Birds, their Specific Gravity, and on the Stomach of Fishes in Relation to Digestion. By JOHN DAVY, M.D., F.R.S. Lond. and Edin., ... 253

[*Turn over.*

PAGE
Notice of certain Remarkable Laws connected with the Oscillations of Flexible Pendulums: With Illustrative Experiments. By Edward Sang, Esq., . 255
Donations to the Library, ... 257

Monday, 16*th January* 1860.

Suggested Explanation of Messrs Carrington and Hodgson's recently observed Solar Phenomenon. By Professor C. Piazzi Smyth, ... 258
On the Fallacy of the Present Mode of Estimating the Mean Temperature in England. By James Stark, M.D., ... 264
Description of the Plant which produces the Ordeal Bean of Calabar. By Professor Balfour, . . 265
Donations to the Library, ... 266

Monday, 6*th February* 1860.

On the Capture of Whales with the aid of Poison. By Dr Christison, ... 270
Notice regarding the Branchial Sac of the Simple Ascidiæ. By Andrew Murray, ... 271
Donations to the Library, ... 272

Monday, 20*th February* 1860.

On the Action of Uncrystallised Films upon Common and Polarised Light. By Sir David Brewster, K.H., F.R.S., ... 273
On Mr Darwin's Theory of the Origin of Species. By Andrew Murray, ... 274
Donations to the Library, ... 292

Monday, 5*th March* 1860.

On the Utmost Horizontal Distance which can be Spanned by a Chain of a given Material. By Edward Sang, Esq., ... 292
On the Climate of Edinburgh for Fifty-six Years, from 1795 to 1850, deduced principally from Mr Adie's Observations; with an Account of other and earlier Registers.—On the Climate of Dunfermline, from the

[*For continuation of Contents, see pp.* iii *and* iv *of Cover.*